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The MPT Assessment Deployed Via Digital Mobile Application

Niall Duffy
Technological University Dublin

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Dublin Institute of Technology
Institiúid Teicneolaíochta Átha Cliath

The MPT Assessment Deployed Via Digital Mobile Application

Niall Duffy

A dissertation submitted in partial fulfilment of the requirements of
Dublin Institute of Technology for the degree of
M.Sc. in Computing (Universal design and assistive technology)

May 2014

DECLARATION

I certify that this dissertation which I now submit for examination for the award of MSc in Computing (Universal design and assistive technology), is entirely my own work and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the text of my work.

This dissertation was prepared according to the regulations for postgraduate study of the Dublin Institute of Technology and has not been submitted in whole or part for an award in any other Institute or University.

The work reported on in this dissertation conforms to the principles and requirements of the Institute's guidelines for ethics in research.

Signed: _____

Date: ***21/5/2014***

ABSTRACT

This project will look at the area of the Matching Person and Technology assessment (MPT). This project will be to develop a version of the MPT that can be deployed as a mobile application. The key research being performed in this project will be the analysis of the results given on the mobile application when compared to those given via the traditional paper method. The MPT is a very large assessment; because of this there are a number of different specific assessments like workplace and education assessments (Cook, A.M. and Hussey, S. 2001). Because of the size of the assessment a section or part of the assessment will be chosen to use for the project. This section will then be created in an application for iOS devices, for example an iPad.

Once the app is created it will need to be tested on people who will actually be taking the assessment or who have done so in the recent past or will do in the near future. The testing will require review and usage of the application by both professionals and test candidates. This type of testing will obviously have to be done in close conjunction with assistive technology professionals. This testing will uncover whether or not the change in format and setting of the assessment has made a difference to the quality or validity of the answers given. The amount of time taken to complete the assessment on will also be monitored over both formats

As the application will be deployed on an iOS device there are a number of other areas that will be looked at during this project that have a direct relationship with both assistive technology and universal design. As this is a new bespoke application it will attempt to be developed from the ground up using universal design, the results of this will be monitored and recorded. As many of the sections of the MPT require further questions to be answered depending on the outcome or a previous question, the computerised application could handle this decision making for the user also. The concept of a game style interface for the application will be looked at also and the results recorded.

Key words: *MPT, Mobile, Application, iOS, Assistive Technology, Universal Design.*

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Special mention needs to be made to Emma and my folks for putting up with me for the last few months, to Andrew also for his help. This project couldn't have been completed without the help of Dr. Marcia Scherer, Dr. Ger Craddock and all the staff of DIT and the NDA.

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1. INTRODUCTION

1.1 Overview of project area

Assistive technology can be defined as ‘any device or system that allows an individual to perform a task that they would otherwise be unable to do, or increases the ease and safety with which the task can be performed’ (Cowan and Turner-Smith, 1999). Unsurprisingly the main area that this project is concerned with is assistive technology. Universal design will also be a major factor in the software design/development section.

The core of this project lays in the Matching Person and Technology Assessment or MPT and in turn the issue of abandonment of assistive technology. Abandonment of assistive technology (AT) occurs when a person either stops using the device after a period of time or doesn’t use it at all. There are a number of factors identified as causes for abandonment of AT, These will be discussed in further detail in the background chapter.

The MPT assessment is administered in order to ascertain the correct AT solution for a person; the assessment was developed by Dr. Marcia J Scherer and is widely known to have very effective results in lowering the percentage of AT abandonment. It has, over time broken into several different assessments based on the situation of the person taking the assessment, For example there are separate assessments for the workplace and children (Scherer & Craddock, 2002). The background chapter of this document will detail the MPT assessment further.

Mobile devices are becoming almost ubiquitous in modern life. The most common of these are either mobile phones or tablet style devices. The most popular devices now operate with common operating systems across both phones and tablets, this allows for a more cohesive environment for users who may have more than one of these devices. The most popular mobile devices today are Apples iPhones and iPad's (iOS devices), or Google Android devices.

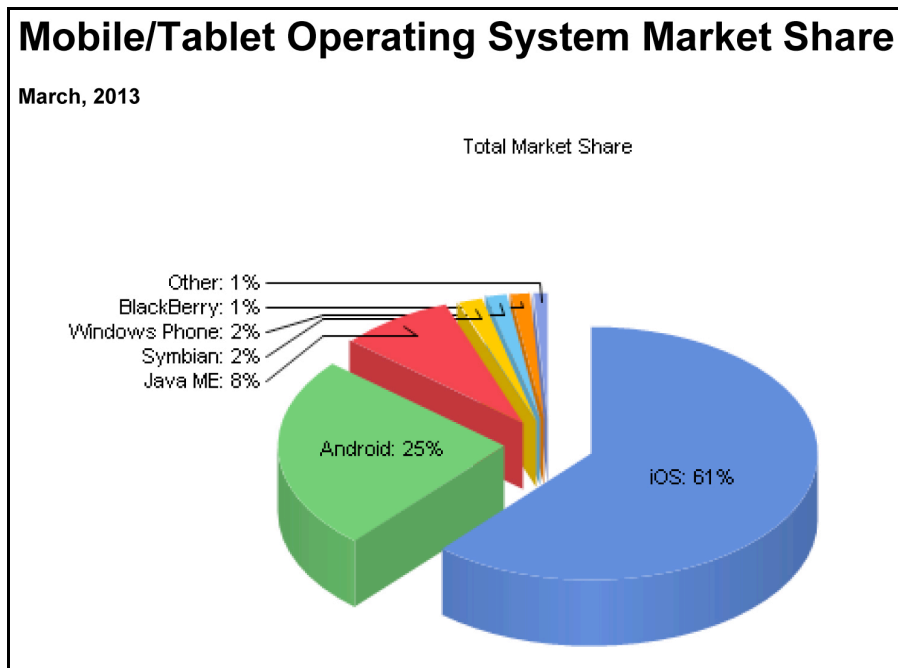


Fig 1.1: Mobile market share 2013

While Apple maintain a model of proprietary hardware and software (Operating system) Google licence their operating system to other manufacturers to use such as Samsung of Acer to name but a few. Third party manufacturers are then free to adapt the operating system technology to suit their own devices should they wish too. Examples of this would be Samsung's Touchwhiz UI or HTC's Sense UI, which are extra user interface layers placed on top of the Stock android software. (Butler 2011)

While the hardware on all these devices is normally similar, large form factor touch screens, powerful processors and high speed Internet as standard on all devices. One of the major factors that have promoted the success of mobile devices such as these has been the ability to run third party applications. All the major providers now allow third parties to create applications for their devices, this feature as allowed these mobile devices to truly become "Smart". Virtually every service can now be conducted via a mobile application, TV services, Mobile banking and booking flights to name but a few. (Goadrich & Rogers 2011)

This project will, at a high level, attempt to marry these very different areas.

1.2 Research problem

The core research problem at hand here is “Can the MPT be deployed as a mobile application”. This question does naturally however gives rise to other key areas of questioning. At this point in time the MPT assessment is a very low-tech tool. While the assessment is indeed distributed on CD-ROM, this is merely a container for printable documents; it is a paper-based assessment. Essentially what is being researched in this project is the feasibility of deploying the assessment as a mobile application and studying the outcomes. Some of the research topics arising from this process are listed below:

- Is the Mobile application more usable than the paper based method?
- Can the mobile application assessment be completed in a shorter time period than the paper-based method?
- Can the number of follow up assessments be reduced using the mobile application?
- Is there a need for the professional to administer the assessment via the mobile application?
- Can the scoring method become automated using the mobile application?
- Can better answers be gathered using the mobile application vs. the paper method?
- What is the current state of play for accessible mobile application development?

1.3 Intellectual challenge

For this project a very thorough understanding of a number of areas will be required. This includes the field of AT and the principles of universal design. A very good understanding of the MPT assessment will be required along with an understanding of its development and history and how it is used at this point in time. Research and understanding of current mobile devices must be obtained along with a very good understanding of accessibility in relation to these devices, an understanding of accessible software design as a whole will also be needed.

For the development of the prototype, knowledge of the different software development methodologies will be needed along with a technical understanding of the development environment and appropriate software testing methods. Structures for usability testing will need to be developed along with an appropriate methodology for carrying them out.

1.4 Research objectives

The following research objectives have been identified for this project:

- Review current areas of MPT, AT, UD and mobile application design.
- From research, design suitable prototype.
- Develop prototype.
- Perform software and usability testing on prototype.
- Assess effectiveness of the prototype in relation to the problem areas previously outlined.
- Document processes, evaluation and conclusions using scientific method.

1.5 Research methodology

A detailed literature review will first be carried out covering the areas of AT, the MPT, Mobile devices and accessible design. Based on this review and consultation with experts in the area, a prototype will be generated. This prototype will then undergo usability testing.

Both qualitative and quantitative methods will be used in this project, for example: It is planned that quantitative information will be gathered via surveys or questionnaires that will be given to users who testing is performed with. From this information further

qualitative information can then be gathered by performing interviews with selected test members. (Galliers & Land 1987)

During the testing phases ethnographic methods will also be used, this is a critical method for any user interface or accessibility design. Either a passive or active approach can be taken during this phase. It is critical that observation during this process is as accurate as possible and that all observations are recorded and reported appropriately. (Crabtree et al. 2006)

1.6 Resources

The following resources were used during this project: DIT library, DCU library, Trinity College library along with Google scholar were all used for the literature gathering and review. Interviews were conducted with staff from the National Disability Authority (NDA) and the National Counsel for the Blind in Ireland (NCBI). Consultation was also carried out with the author of the MPT assessment, Marcia J Scherer. Dr. Scherer was also kind enough to provide a copy of the MPT assessment along with the scoring methods used with the MPT for use in this project.

For the software development process the following resources were used: an Apple Mac computer, Access to an iPad for testing purposes along with the Xcode IDE and iOS SDK. An Apple developer account was also purchased in order to deploy the application to the physical device and to gain access to the online iOS development library. Google apps was also used to provide questionnaires.

1.7 Scope and limitations

The scope of this project needs to be clearly defined – This is not a software development project. The goal of this project is to create a usable prototype of a section of the MPT assessment and to test the results in a scientific manner, which will then be documented and evaluated accordingly. The entire assessment will not be replicated in a digital mobile format, nor will the entire scoring system. Limitations

may also be reached in terms of the levels of testing that can be carried out, due to ethical issues and appropriate access to suitable test candidates.

1.8 Organisation of the dissertation

This dissertation is organised into six different chapters, The First is the introduction which is now finished, following this will be: Chapter 2 – this will give a background and literature review to the dissertation, Universal design, assistive technology, the MPT, mobile devices and applications will all be covered, Including how this project links them all together. Chapter 3 – Illustrates the development process of the application, this will detail the technical development, methodology used and challenges encountered throughout the process. There will also be a detailed usage manual for the prototype application included in this section.

Chapter 4 – this will then detail the testing performed on the application. This will include both software testing and usability testing and the methodologies employed during these processes. Chapter 5 will look at the experiment and evaluation of the project as a whole, this then flows into Chapter 6 which looks at the conclusion of the project and dissertation and defines the contribution to the body of knowledge and the future work and research that is recommended.

This chapter has out lined the following: a brief overview of the problem area, a breakdown and explanation of the research problem, an overview of the intellectual challenge at hand, a listing of the objectives associated with the project, detailed the research methodology of the dissertation. The resources used during this project and production of this dissertation are listed along with the scope and the structure of the document. The next chapter is the background chapter this will provide the literature review section of the dissertation and gives greater detail on the different aspects of the project/dissertation.

2 BACKGROUND

2.1 Introduction

This chapter will detail the background and literature review section of the project, it is structured as follows: In section 2.2 an outline of the areas of assistive technology and universal design are detailed. Section 2.3 gives the background to the Matching Person and Technology assessment; it will cover its development, structure, and the current process of assessments given.

Section 2.4 will give a brief history of mobile devices along with a brief overview of currently available devices and examine the accessible features of each. Mobile applications and the concept of accessible design for mobile applications will then be examined in section 2.5. There then follows a conclusion to the chapter in section 2.6

From the research conducted in this section a high level view of what will be needed to be included in the prototype design will be ascertained.

2.2 Assistive technology

The topic of Assistive technology (AT) is at the core of this project, essentially what is being looked at is developing a piece of assistive technology that will in turn be used as a predictor for AT abandonment. AT is a very large area in its self, this section will provide research into firstly low - medium tech AT in section 2.2.1 then high tech AT in Section 2.2.2, Looking at further examples of assistive technology in 2.2.3 and then at the problem of AT abandonment in section 2.2.4.

A good understanding of AT is needed for this project because, as previously stated the prototype being developed needs to be fully accessible and its self act as a piece of assistive technology for the end user.

2.2.1 Low - medium tech AT

Low to medium assistive technology covers a very wide area; low tech would be any kind of AT that requires no computers or even electrical power to work and are normally of little or no cost. Considering this the number of low tech AT devices that are currently in use is staggering, everything from standard walking sticks to magnification devices can technically be counted as low tech AT solutions. One common area that low tech AT solutions are used in is augmentative or alternative communication solutions, where a simple set of pictures or phrase cards are used to communicate (Blackstone et al. 2007). It is important to have knowledge of low tech AT, as the MPT assessment is currently a low-tech format. Examples of how low tech AT have been transitioned into high tech solutions are given in section 2.2.2.



Fig 2.1: Low tech AT

Medium tech AT is naturally, usually more complicated than low tech AT. Typically some level of computer components that do not have any high level processing power. The most common forms of medium tech AT are generally adaptive computer peripherals such as specialist mice or keyboards (Fig 2.2). There are also specifically designed medium tech AT tools, If we look at the AAC example in Figure 2.1 the medium tech equivalent to this would be an electronic board that is capable of speaking aloud the selected phrases (Todman & Alm 1997). One of these devices is shown in figure 2.3.



Fig 2.2: AT computer peripheral

The device shown in Fig 2.3 would typically not have any computational ability at most it would either speak pre-programmed phrases or allow a user to record phrases for playback once a button has been pressed. Medium tech AT devices can however come at high prices; this is mostly due to their relative obscurity.



Fig 2.3: Medium Tech AT Device

2.2.2 High tech AT

High tech assistive technology is generally devices with high processing power. Traditionally they would have been bespoke designs such as heavily modified laptop or computer solutions such as the one shown in Figure 2.4. These types of solutions generally require specialist support and training they also are usually very costly.



Fig 2.4: High Tech AT Device

Recently high tech AT has begun to move away from these bespoke solutions however. There is an increasing trend in AT being deployed as software on off the shelf devices such as standard computers or tablets. Once again these often come at a high price and can also require training and support. (van de Sandt-Koenderman 2004)

Because of its nature high tech AT can also range very widely in its functionality, Software based screen readers such as JAWS would be classed as high tech AT. An example of a low tech AT solution that has been deployed as a high tech one would be the Proloquo 2 go software, This again is an AAC solution and brings the picture card example shown in the low and medium tech sections into the high tech realm (Figure 2.5).



Fig 2.5: High tech AAC

2.2.3 Further examples of assistive technology

Assistive technology is essentially an umbrella term for many different areas of technology, all centred around devices for people with disabilities. Some of the main areas of AT are: Mobility impairment devices – these would include Wheelchairs and walker-style devices, A typical walker device is shown below in Figure 2.6



Fig 2.6: Mobility walker

Prosthetics are another example of assistive technology, Currently an emerging trend in this area is the replication of human muscle and skeletal structures using biomechanical devices to either enhance or replace motor control that may have been

damaged or lost through injury or disease. Assistive technology in sport is another rapidly emerging area. Figure 2.7 shows a game of wheelchair hurling.



Fig 2.7: Wheelchair hurling

2.2.4 Abandonment

Assistive technology abandonment or discontinuation occurs when a user stops using their AT device. This can happen for a number of reasons; a disregard for the consumers' preferences in technology selection is a significant factor (Philips & Zhao, 1993). Surveys have shown that almost one third (29.3%) of all assistive technology devices become completely abandoned (Philips & Zhao, 1993).

Other studies have shown that consumers, who do not believe that they are involved in the selection of their assistive technology devices, are more likely to discontinue using them than individuals who feel involved (Carroll & Phillips, 1993; Freeman & Field, 1994; Phillips & Broadnax, 1992; Tewey, Barnicle, & Perr, 1994; Turner, et al., 1995).

2.3 *MPT*

Dr. Marcia J Scherer developed the matching person and technology assessment and the process in which it is administered. Advances in technology saw the range of different AT devices and solutions rise significantly, in turn many of these devices had their own specific functions and features also. The assessment was developed in order to attempt to alleviate any confusion or feelings of overwhelmedness that may have

been experienced by people trying to make decisions regarding devices selection. The MPT process comprises of a number of different parts that are called instruments, unlike other assessments these instruments take into account the following factors:

- The environments in which the person uses the technology,
- The individual's characteristics and preferences, and
- The technology's functions and features.

These factors have a major influence over whether the technology selection. Should any of these areas show up too many negative influences, there is a much higher chance that the technology may not be successful or even abandoned. The MPT consists an initial survey and then four technology specific forms as detailed below in an excerpt form the matching person and technology website:

The MPT process contains a series of instruments:

- *For persons considering any kind of technology, but believe there may be a general reluctance to use technology, the Survey of Technology Use (SOTU) helps identify technologies an individual feels comfortable or successful in using so that a new technology can be built around existing comfort or success.*

Technology-specific forms are:

1. *The Assistive Technology Device Predisposition Assessment (ATD PA) to help people select assistive technologies.*
2. *The Educational Technology Predisposition Assessment (ET PA) to help students use technology reach certain educational goals.*
3. *The Workplace Technology Predisposition Assessment (WT PA) for employers, vocational counselors, etc. who introduce new technologies into the workplace and who train persons in their use.*
4. *The Health Care Technology Predisposition Assessment (HCT PA) for health care providers who recommend or prescribe technologies for health maintenance, pain relief, and so on.*

Each of the technology specific forms is split into two, one for the administrator of the assessment to complete and the other for the person taking the assessment to complete. A sample of one of the technology specific forms is shown below in Figure 2.8 and further examples can be viewed in Appendix B.

Initial Person		Assistive Technology Device Predisposition Assessment CONSUMER FORM		FORM 4-1 CONSUMER			
Name _____		Age _____					
Primary Goals (6 months) _____		Today's Date _____					
Primary Goals (1 year+) _____		Form completed by _____					
A. How would you rate your abilities today in the following 9 areas when using your current AT or other support? <ul style="list-style-type: none"> For items 1-9, mark the best response (1 for <i>poor</i> through 5 for <i>excellent</i>). Under <i>Name of Support</i> write the name of the support you use where relevant (example: 'eyeglasses' for # 1, <i>seeing</i>). Write a plus [+] in the spaces where you expect to need more support over the next year (example: 'eyeglasses' gets [+] if you'll expect to need stronger lenses during the next year). Write a [-] in the spaces where you expect to need less support, and a [0] where you expect your support should stay the same over the next year. 							
	Poor	Average			Excellent	Name of Support	Need more [+], less [-], same [0]
1. Seeing	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	_____	_____
2. Hearing	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	_____	_____
3. Speech	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	_____	_____
4. Understanding, remembering	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	_____	_____
5. Physical strength/stamina	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	_____	_____
6. Lower body use (hips, legs, feet)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	_____	_____
7. Grasping and use of fingers	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	_____	_____
8. Upper body use (arms, shoulders, trunk)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	_____	_____
9. Mobility (getting from place to place)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	_____	_____
B. How satisfied are you currently in the following areas? <ul style="list-style-type: none"> For items 10 – 21, mark the best response (1 for <i>Not Satisfied</i> through 5 for <i>Very Satisfied</i>). Which 3 items are most important to you? Under <i>3 Most Important</i>, write #1, #2 or #3 for the three areas that concern you most (#1=most important). Leave the other lines blank. For your 3 <i>Most Important</i> items, write the primary obstacles and barriers you face in the space beside that item. 							
	Not Satisfied	Satisfied			Very Satisfied	3 Most Important	
10. Personal care and household activities	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	_____	_____
11. Physical comfort & well-being	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	_____	_____
12. Overall health	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	_____	_____
13. Freedom to go wherever desired	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	_____	_____
14. Participation in desired activities	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	_____	_____
15. Educational attainment	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	_____	_____
16. Employment status/potential	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	_____	_____
17. Family relationships	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	_____	_____
18. Close, intimate relationships	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	_____	_____
19. Autonomy and self-determination (choosing)	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	_____	_____
20. Fitting in, belonging, feeling connected	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	_____	_____
21. Emotional well-being	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	_____	_____
C. Please mark all the statements below that describe you. Mark only those that <i>frequently or often</i> apply to you and ignore those that <i>very rarely or never</i> apply to you.							
<input type="checkbox"/> 22. I have the support I want from family	<input type="checkbox"/> 33. I am usually calm and patient	<input type="checkbox"/> 44. I find technology interesting					

Fig 2.8: MPT Sample

The MPT's main goal is to ensure that people feel an involvement in the technology choice process and to move away from a model where by people are assigned a solution that may not suite them as a person. This is a goal that should persist regardless of the platform that the assessment is delivered on.

Table 1: MPT Process (Scherer & Craddock 2002)

Step 1	Worksheet for the Matching Person and Technology (MPT) Model is used to determine initial goals that the professional and the user have established, including possible alternative goals. Second, potential interventions supportive of these goals are written in the space provided on the form. Third, any technologies needed to support the attainment of the goals are recorded.
Step 2	Technology Utilization Worksheet for the Matching Person and Technology (MPT) Model is used to identify technologies used in the past, satisfaction with those technologies, and those which are desired and needed but not yet available to the consumer. The professional and consumer complete this form collaboratively.
Step 3	The consumer is asked to complete his or her version of the appropriate form depending on the type of technology under consideration (general, assistive, educational, workplace or healthcare). The user form may serve as a guide for an oral interview, if that seems more appropriate for the situation. The professional completes the professional version of the same form and identifies any discrepancies in perspective between the professional's and the consumer's responses. These discrepancies then become a topic for discussion and negotiation.
Step 4	The professional discusses with the user those factors that may indicate problems with his or her acceptance or appropriate use of the technology.
Step 5	After problem areas have been noted, the professional and consumer work to identify specific intervention strategies and devise an action plan to address the problems.
Step 6	The strategies and action plans are committed to writing, for experience has shown that plans that are merely verbalized are not implemented as frequently as written plans. Written plans also serve as documentation and can provide the justification for any subsequent actions such as requests for funding or release time for training.

2.4 Visual impairment

From consultation with Dr. Scherer the decision was made that this project would focus solely on people with visual impairments. The advice from Dr. Scherer is below and the full email thread can be found in Appendix A.

“I think I would focus initially on people with vision loss. It's easy to either avoid sound or provide text to go along with it. As for mobility, probably the biggest concern would be dexterity and finger control -- solving that is more of a hardware issue in my mind.”

This recommendation is helpful in relation to the scope of the project also as it may not have been possible to create a functioning prototype that needed to cater for a much larger catchment area of impairment or disability.

2.4.1 Impairment types

The world health organisation states that world wide 285 million people suffer from visual impairment and 39 million people are blind. It is important at this time to state that visual impairment and blindness are different things. Blindness would indicate a full lose of visual senses while visual impairments can be categorised into moderate or severe cases. Some of the most common causes of visual impairment are listed below while Figure 2.9 shows the effects of two of these conditions on a person's vision (Kent.gov.uk).

- Glaucoma
- Age-Related Macular Degeneration
- Cataract
- Diabetic Retinotherapy
- Myopia
- Retinis Pigmentosa



Fig 2.9: Macular Degeneration (left) & Retinis Pigmentosa (Right)

2.4.2 Common AT solutions in use

The most common form of High tech AT in use by people with visual impairments or blindness would be screen reader software, this kind of software runs on computers and reads aloud the content that is on the screen to the user. Screen reader software is normally controlled by keyboard presses. The number of different combinations and commands needed to control the software is usually very high. This generally means two things, firstly some sort of training or tuition is needed when first using the software and secondly while different software packages are available, people are less likely to swap to a different one as it means having to learn a new system. (Miyashita et al. 2007)

The most popular screen reader software available is called JAWS (Job access with speech). A survey from webaim.org to over 1000 screen reader users returned the results shown in Figure 2.10, showing JAWS with 74% usage

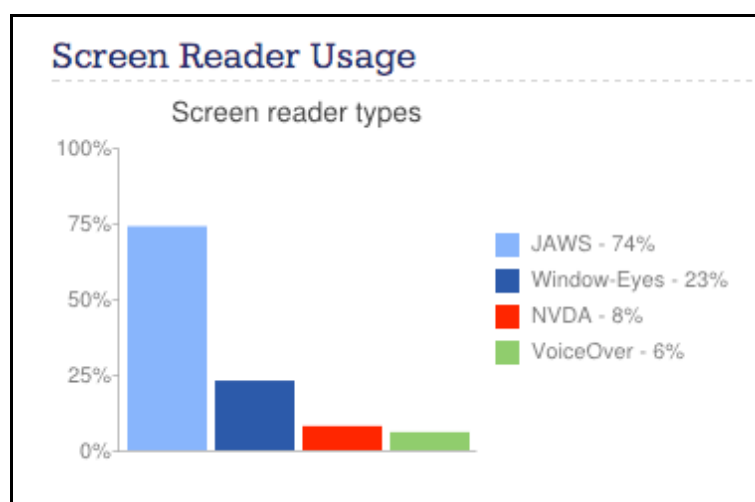


Fig 2.10: Screen reader usage

A study conducted in 2007 by Lazar, Allen, Kleinman and Malarkey for the international journal of human computer interaction looked what frustrated screen reader users when using their computers to browse the Internet. This Study surveyed one hundred blind users. 84% of these users in this study used the JAWS screen reader software. Figure 2.11 shows the outcomes of this study and what these users reported as being the most frequently frustrating things when using a screen reader. It is important to this project to note these frustrations so as they can be catered for when designing for a new platform.

<i>Causes of Frustration</i>	<i>Number of Occurrences</i>
Alt Text	
No alt text for pictures	18
No alt text for pictures-required registration	5
Nondescriptive alt text	10
Links	
Misleading links	15
Link not working	3
Couldn't find link	5
No skip navigation	3
Forms	
Poorly designed/unlabeled form	23
Plug-ins	
Inaccessible Portable Document Format (PDF)	15
Inaccessible Flash	12
Java applets causes problems	3
Active X not working	1
Windows Media Player/Real Audio not working	8
Navigation	
Auto-refresh causes screen reader to continually restart	5
Broken back button	4
No frame name	2
Timed out	1
Can't find info	2
Mouse required for navigation	1
Layout	
Page layout causing confusing screen reader feedback	36
Pop-up frustration	13
Table won't read linearly	1

Fig 2.11: Causes of screen reader frustration

While these items are all web specific such as Links and forms, the same concepts apply across all software developments. For example the problem of misleading or broken links would be similar to that of misleading buttons or Menus. Considering these frustrations in the design will help in creating a better end product for the user.

2.5 Mobile devices

The prototype for this project is to be deployed on a mobile device, this section looks at the background of mobile devices and the factors that are essential to consider when choosing the correct mobile device for the prototype.

2.5.1 Advances

The advances in mobile computing in the last 10 years have been massive. With computer technology getting ever more powerful and smaller at the same time it is now possible for mobile phones to have the same processing power and memory capabilities as many computers. This coupled with the falling costs of such technologies has allowed a massive boom in the number of “Smart phones” both being developed and sold.

Along with smart phones the number of tablet devices being sold is now at its highest level. These tablets are typically a larger form factor than smart phones but normally share similar operating systems and technological specifications. Figure 2.12 shows the number of tablet sales versus typical PC’s and mobile PC’s for the past four years along with the forecast for the next three where it can be seen that tablets will overtake traditional computers by 2015.

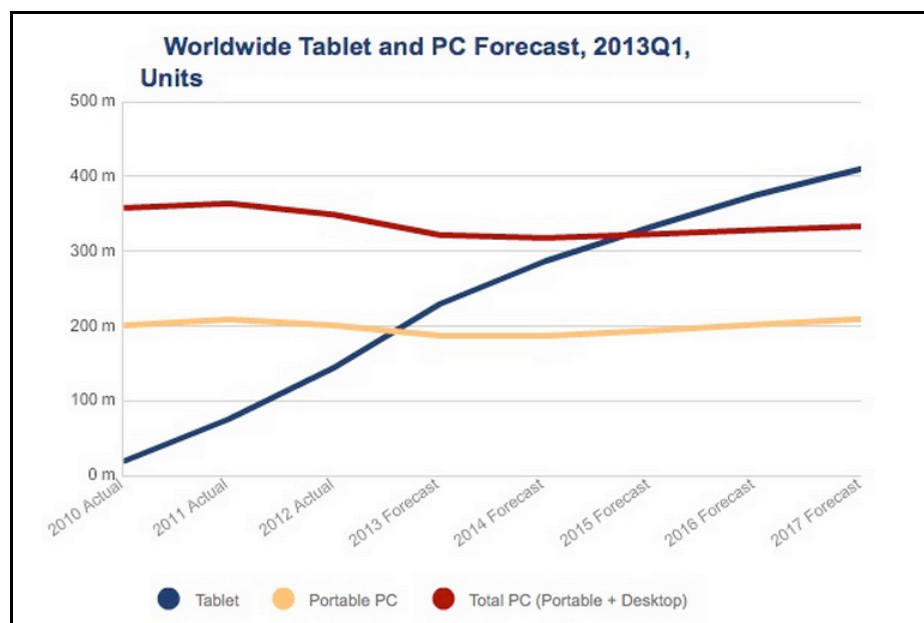


Fig 2.12: Tablet sales forecast

In terms of assistive technology this trend is taking effect as well. From consultation with Dr. Scherer she stated the following:

“As for the number of people using Smartphones and iPads, the number is growing every day. In fact, AT industry folks who make specialized products for people with disabilities think they may be out of business in a few years.”



Fig 2.13: iPad Mini

2.5.2 Trends

While the industry of smart phones and tablet computing was in its infancy there were many different companies that attempted to corner the market. However over time two separate trends began to emerge. These two trends involve different sales and development models. The two front-runners in the market have emerged to be Google and Apple, although both have by far the largest market shares, they cannot be compared fully as they follow different models (Goadrich & Rogers 2011).

While Apple prefer to control the experience of using one of their devices very closely by manufacturing the physical hardware along with the bespoke software to run on it. Google have employed a model of creating only the software and then licencing it out to manufacturers who are the allowed effectively do what they want with it. This has allowed companies like Samsung and Acer to become major tablet sellers without having to build or maintain their own operating system for the devices. While both Google and Apple do share a common trend in the model they employ for the

development and distribution of applications to their devices this topic will be covered further in section 2.6.

2.5.3 Accessibility features

There is a marked difference between the accessibility features on both platforms, This is primarily down to the different distribution models discussed above, while Apple build in their own accessibility features to their devices, Google android manufacturers are expected to add accessibility features the software themselves. This means devices running Google software do not have a uniform set of accessibility features.

The standard features available on the latest version of Apples iOS software are numerous. Out of the box every device comes with the ability to provide Voice over, Zoom functions, inverted colours, system wide large fonts and bold text and increased contrast. In addition to this the devices are now capable of wirelessly connecting to many common hearing aid devices and also allow control via switch access either by use of the devices touch-screen, a physically connected switch device or even by pre determined head movements that the devices front facing camera will scan for.

The gulf between the two platforms accessibility features is a serious factor in the choice of development platforms. Both platforms do have standard guidelines for usability and designing for accessibility, these guidelines will more than likely be heavily relied on during the development process. ([Developer.apple.com/accessibility](https://developer.apple.com/accessibility))

2.5.4 Choice

There are two major factors to choosing the platform that the prototype development. Firstly iOS devices have a larger market share, 61% versus Google's 25% as shown in figure 1.1. Along with this there is the aforementioned gulf between there built in accessibility standards.

2.6 *Mobile applications*

Mobile applications or “Apps” are the biggest feature of modern mobile devices. While the device and software are proprietary it is now possible for any business or anyone effectively to create an App As Google and Apple are the largest players in the

market, they naturally provide the largest market places for the applications that can be installed on their devices. The “Play Store” is the Google market place while the “App Store” is the Apple equivalent.

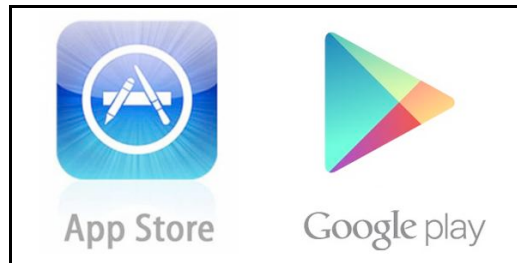


Figure 2.14: Store logos

The manner in which applications are developed for both platforms is entirely separate. While development for Google devices is done via the Java programming language iOS development is done through the objective C language. Because of this there would have initially have been a gap between the apps that were available on each device, E.G. an app may be available for one but not the other, However given the almost two horse race that has emerged most developers see a need to provide apps for both rather than just one now. (Kimbler 2010)

2.6.1 Web apps

When the two platforms were relatively new a type of App that could be run independently of device was often advertised, this was called a “web app”. We apps are not available via the proprietary market places for each platform; they are essentially no Applications as such either. This type of app is merely a bookmark to a website that would be saved to the phones home screen, When the bookmark is tapped the web page would load, normally using either cascading style sheets or a web programming language the website would then adapt to suit the device it was being loaded on. These kinds of apps have become eve increasingly unpopular as native app development for the platforms has become easier. Web apps could never compete with native apps at they do not have the same level of control over the hardware elements of the devices as native apps do. (Charland & Leroux 2011)

2.7 Accessible software design

It is important to recognise that there are no set standards for accessible native app design yet ratified or in place. This section will outline some of the current guidelines in place for accessible software design. Development for mobile devices is software development so without a defined set of standards of guidelines the most appropriate guidelines from software design will need to be adapted accordingly.

2.7.1 Universal design

When looking to design anything it is essential to consider the concepts of universal design. Universal design is a high level set of seven principles that were developed by a varied group of professionals in 1997 that included Engineers, architects and design researchers. The seven principles are as follows:

- Principle 1: Equitable Use
- Principle 2: Flexibility in Use
- Principle 3: Simple and Intuitive Use
- Principle 4: Perceptible Information
- Principle 5: Tolerance for Error
- Principle 6: Low Physical Effort
- Principle 7: Size and Space for Approach and Use

It should be attempted to guide all design decisions by these principles, For software design principle six and seven may not immediately stand out as being particularly poignant however they do still provide good guidance when it comes to user interface design when considering the amount of movement that might be needed between button presses or if the software was going to be used with a peripheral input device. It is also necessary to understand that these are a set of principles rather than rules or guidelines and should be adhered to at a high level within the design process.

2.7.2 W3C mobile accessibility

The World Wide Web Consortium (W3C.org) is the main international standards organisation for the World Wide Web. Again while web content may not be directly applicable to native mobile app design the web content accessibility guidelines (WCAG) do provide an acceptable set of guidelines to consider for mobile app development. Four core areas define the WCAG, these are:

- Perceivable
- Operable
- Understandable
- Robust

Each of these guidelines contains points that are applicable to mobile app design. Under perceivable falls the guideline for providing text alternatives for non text content. Under operable the guideline for helping users navigate and find content while also being able to determine where they are, this is also just as important for app design. Making the content and structure of the application both understandable and robust are also important guidelines to follow in the development process.

2.7.3 Application accessibility guidelines

The National Disability Authority of Ireland (NDA) has also developed a set of guidelines for application software accessibility. These guidelines coverer in great depth the different aspects to consider when designing or developing software in general.

Once again while not being specific to mobile app development a number of the guidelines are applicable to this kind of development. These guidelines are broken into two priority levels, Priority 1 & 2. The guidelines that are suitable for use with mobile application design are listed below:

- Priority 1.
 - Ensure that users have access to the operating system accessibility tools, without affecting application functionality.
 - Ensure compatibility with assistive technologies.
 - Adhere to all user-selected system settings for input and output.
 - Ensure that all information can be perceived by users with restricted or no vision.
 - Ensure that all information can be perceived by users with restricted or no hearing.
 - Do not cause the screen to flash at a frequency of above 2 Hertz.
 - Use the simplest language possible for instructions, prompts and outputs and, where possible, supplement it with pictorial information or spoken language.
 - Provide descriptions and instructions for all accessibility features.
 - Provide accessible documentation, training and support materials.

- Priority 2.
 - Allow sufficient response time to accommodate the slowest users.
 - Ensure that the user interface and task flow is similar across different functions.
 - Adhere to the operating system user interface guidelines.
 - Provide accessible packaging, installation and configuration tools.
 - Provide for users with multiple impairments.

2.7.4 Apple & Google user interface guidelines

As mentioned previously both Apple and Google have user interface guidelines for developing on their platforms. For Google android these guidelines are of a very high level, simply outlining their creative vision and principles for design. Apple however set a much stricter set of guidelines; in fact they are really rules for development on iOS rather than guidelines as failure to adhere to them means that your app will not be accepted for distribution. (Rana & Rana 2009)

2.8 Software development methodologies

Given that this project involves some software development, it is necessary to look at some of the high level methodologies that are in use when performing software development. A development methodology provides a framework that can be used to guide the overall development process this helps with structure planning and control of the project.

2.8.1 Waterfall

The waterfall model is a downward flowing sequential model for software development. It simply outlines each of the stages involved in developing and the flow from one to the other. Figure 2.15 shows the basic waterfall model. While more elaborate versions of this model have been developed, Some involving either more stages or a cyclical stage where a pervious stage may be repeated based on the outcome of a logical operator appended to a later stage. It is important to understand the flow of a software development project as outlines in this methodology, an understanding of how feeding requirements into design and then implementing from this design is critical to any software project. (Simao 2009)

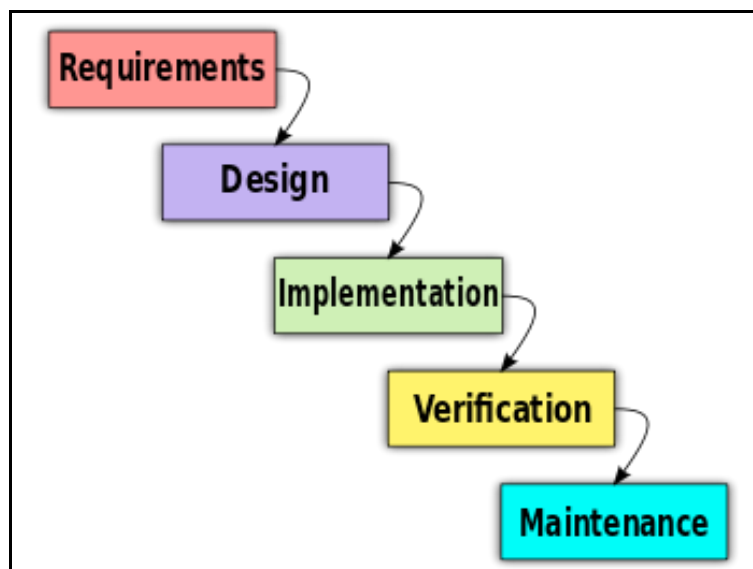


Fig 2.15: Waterfall model

2.8.2 Prototyping

While prototyping is not a full methodology in itself it a critical part of many larger software development methodologies or lifecycles. This approach involves the generation of prototypes; these incomplete versions are developed in order to fulfil the basic requirements of the design. Figure 2.16 shows the prototyping section in a software development methodology. (Simao 2009)

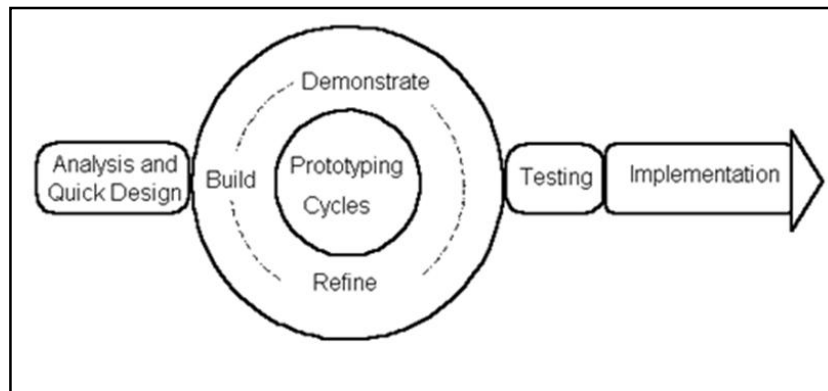


Fig 2.16: Prototyping

2.8.3 Spiral

The spiral software development methodology as shown below in Figure 2.17, in this methodology the timeline works out from the middle and flows through the analysis, evaluation, development and planning stages repeatedly. (Simao 2009)

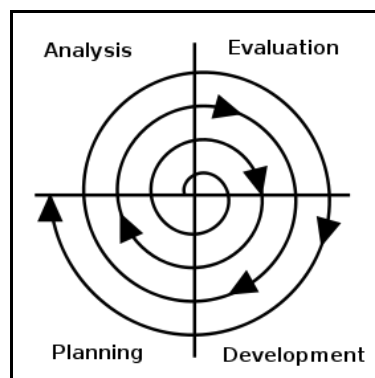


Fig 2.17: Spiral model

2.9 Conclusion

This section has looked at each of the separate aspects of the project, Assistive Technology, The Matching Person and Technology assessment, visual impairment, mobile devices, mobile applications, guidelines for accessible software design and software development methodologies were all covered.

The reason for this research was to develop a high level design to bring into the next stage of the project; this design will be used to guide the development process.

2.9.1 Design

- Ensure the transition from low tech to high tech.
- Involvement by the user in the in the process was identified as a major aspect of the assessment, this must be maintained.
- The assessment process must be quick and simple to complete.
- Feed back from the Screen reader frustration study must be considered during the user interface design.
- The application will be developed as a native app as web apps cannot provide the same functionality and are no longer in popular usage.
- Given the lack of standard accessibility features on Googles android platform and Apples market dominance the development should take place on the Apple iOS platform.
- The methodology that will be used for development should use some form of prototyping, as this will suite the mobile development process well.
- A non-exhaustive set of principles guidelines and rules have been defined to adhere to during the development process. These should also be referred to during any testing phases to monitor the levels at which the end software solution sticks to these.

3 DEVELOPMENT PROCESS

3.1 Introduction

From the introduction and background chapters we have outlined both ether requirements and the design for the software development section of this project. Importantly it was identified that the prototype will be developed for the iOS platform, Further detail about development on this platform will be provided in this chapter.

The layout of this chapter will be as follows, Firstly section 3.2 will give a greater detail about the development methodology that is in use, sections 3.3 – 3.6 will then look at the platform for development, the User interface design, back end and deployment of the prototype. Section 3.7 will detail challenges that were experienced during the development process and finally section 3.8 will discuss the conclusions from this chapter and the development process.

3.2 Methodology

The methodology that will be used is Evolutionary prototyping, this methodology uses the concepts of prototyping discussed in the background chapter in a different way than traditional throwaway prototyping; where prototypes are built from scratch and discarded after each revision. Evolutionary prototyping dictates that a robust prototype is developed and then constantly evolved upon there after.

While this methodology is commonly used in projects where the requirements or features are not known – that is not the case in this project. In this case it is being utilised due to the scope of the project, without a team of developers it is better not to commit to developing new prototypes from the ground up on each revision. This type of methodology is also appropriate; as slight changes to the prototype will more than likely need t be added as non-conformances with the accessibility guidelines are discovered. (Gordon & Bieman 1995)

3.3 Platform

As previously discussed the platform that has been chosen for development is Apples iOS. iOS is the operating system that runs on all of Apples mobile device range. iOS 7 is the latest revision and every new device now ships with this version of the software. The development of this project began on iOS 6, however when the latest version was released it was decided that the development would move to the newer software.

This was due to two reasons. Most of the changes in iOS 7 were graphical and not very much of the apps user interface had been developed at the time and iOS 7 also introduces a number of new accessibility features to the platform including control via switch access and on screen captioning as previously discussed. Figure 3.1 shows the graphical difference between the home screens of an iPhone device running both versions of the software.



Fig 3.1: iOS 6 & 7

3.3.1 Differing form factors

As mentioned the iOS software runs on several different platforms. These include two different iPhone devices and two different iPad devices. While all of these devices have more than enough processing power and memory to easily run the application being developed, the iPad devices do have much larger screens. Along with this the larger housing allows for a larger battery and louder and clearer speakers. Given the scope of the project the iPad is the best device to develop the prototype for. Figure 3.2 shows the size difference between an iPhone and an iPad.



Fig 3.2: iPhone and iPad

3.3.2 Xcode

Regardless of the device being developed for, every native application that runs on an Apple device has to be developed using Xcode, this is Apple's Integrated development environment (IDE) and is free to download either through the Mac app store or from the developer website. The latest versions of Xcode come with the most recent iOS software development kit (SDK). Should you wish to develop for older versions of iOS or indeed newer versions are released before an iteration of Xcode then the iOS SDK's can also be downloaded from the Apple developer website. (Anderson 2012) Figure 3.3 shows the Xcode IDE modifying a header (.h) file of an iOS development project.

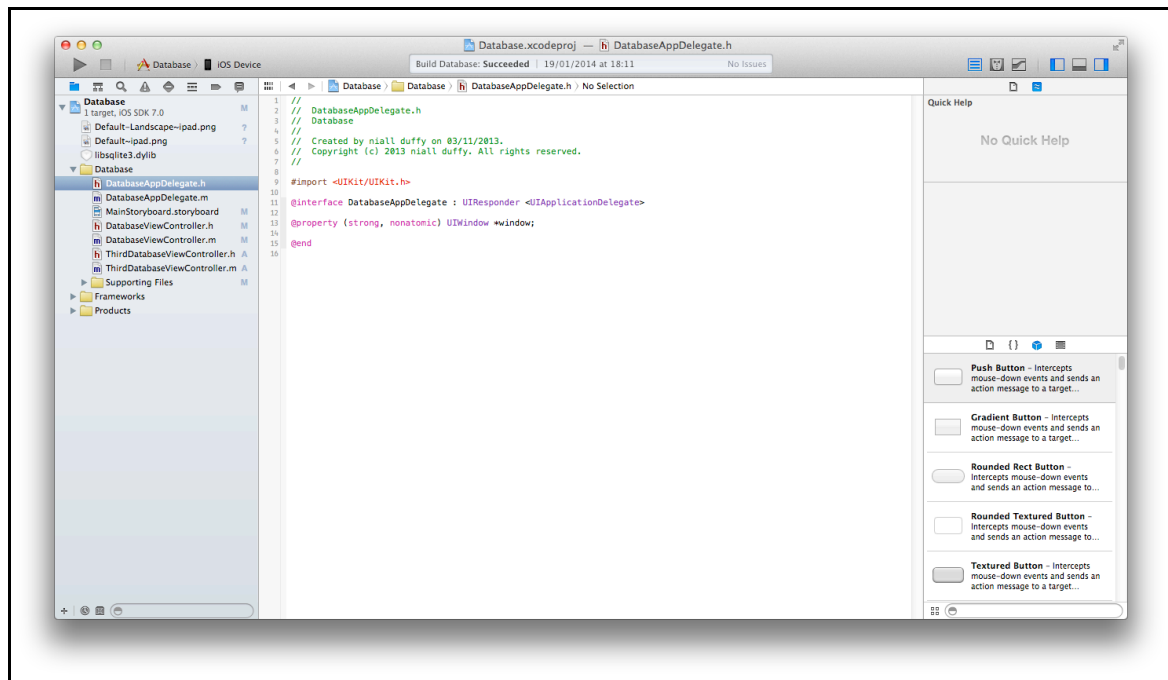


Fig 3.3: Xcode

3.3.3 Storyboard development

Previous versions of Xcode used a program called interface builder to create the user interface of applications. This allowed developers to create the user interface of their applications graphically in a drag and drop style method. The functionality of the different user interface elements would then be written in code and linked to the interface builder files.

The latest versions of Xcode now use a method called storyboarding to allow developers to create the user interface of their application. This can be done from within Xcode and does not require the separate interface builder tool. While all the same drag and drop functionality of interface builder still exists, transitions between graphical views and even pop over or sub views can now be added using this storyboarding tool without the need for coding (Allan 2010). Figure 3.4 shows some of the different graphical views from one of the very early prototypes of this project. The lines between views represent different transitions activated by button presses. This entire storyboard was generated in Xcode without writing a single line of code.



Fig 3.4: Storyboard example

3.3.4 iOS simulator

The Xcode IDE also comes with an iOS simulator; this allows you to simulate your app on your development computer before deploying it to a physical device. While it does not allow you to test all functionality (including accessibility features), it does provide a quick method to check the look and feel of your app and to test any coded features that may have been added. Events such as pressing the home button, switching between apps, simulated call interruptions and simulating high memory usage are all available through the iOS simulator. Figure 3.5 shows the iOS simulator running iOS 7 on an iPhone with a four-inch display.

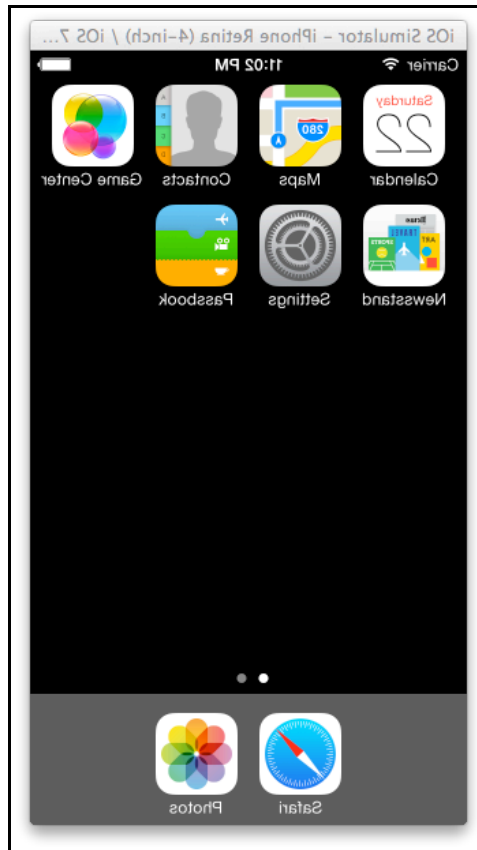


Fig 3.5: iOS Simulator

3.4 User interface

The user interface for the prototype was using the storyboard tool, an effort was made to keep the design as simple as possible in order to facilitate both the ease of sighted users when using the app but also to allow the accessibility tools to be best able to navigate the and adapt to the user interface.

3.4.1 Elements

Only a small number of UI elements were used in the app. This was again in order to keep the app as easy as possible to use. A uniform layout for every page was adopted and buttons remain uniform throughout the app. Text labels, editable text fields, standard buttons and multi section buttons are the only elements used in the prototype. While different elements were used in earlier versions of the prototype; as the

development continued it became clear that it was better to keep the UI as simple as possible. Some elements (Simple label and text field) are shown below in figure 3.6.



Fig 3.6: UI Elements

3.4.2 Transitions

Because of the final layout of the app there is a large number of UI view transitions in the final prototype. As standard these transitions are animated in iOS apps. These animations were removed from the final prototype, as it is best practice in order to facilitate a number of third party accessibility tools by not having any animations in the app software.

3.4.3 Accessibility features

During the development process every effort was made to ensure that all the accessibility features of the device were allowed to perform to their best ability in the final application. This included Providing both descriptor text and hint text for every UI view/screen and every element contained within each of the UI views/screens of the application. Doing this allows features such as the built in voice over and the “selection speak” feature to work to the best of their ability.

By making the UI as simple as possible again the voice over feature is facilitated better. In addition to this the simple UI design allows the switch access control to move through the app both more easily and uniformly. The inverted colours feature is also served well by having a simple UI.

3.4.4 Screen shots

Below in figure 3.7 is a screen shot of the final user interface design, Further screen shots of the app can be viewed in Appendix C.

iOS Simulator – iPad / iOS 7.0.3 (11B508)

ATDPA Consumer: Section A

How would you rate your ability in the following 9 areas when using your current AT or other support?

	Poor - Excellent	Name of support	
1. Seeing	1 2 3 4 5	eye glasses	+ 0
2. Hearing	1 2 3 4 5	hearingaid	+ 0
3. Speech	1 2 3 4 5	speech	+ 0

Next >>

Fig:3.7: Screen shot of interface

3.5 Back end

While the user interface of iOS applications is generally constructed using the storyboard tool within Xcode, each of the views/screens created must have back end constructed using a programming language; for all Apple based apps this programming language is Objective-C. Like C++ Or Java; Objective-C is based on the C programming language but provides an abstraction layer on top that facilitates object-orientated programming. Unlike most high level programming languages Objective-C does not provide automated garbage collection for memory allocations. This means that memory must be manually allocated for objects or methods that are created and the subsequently de-allocated when the program or app has finished using it. Xcode provides a memory leak analyser tool to test if you app is not correctly handling memory, this will be looked at further in the testing chapter.

It is this Objective-C programming layer that allows complex procedures to be attached to elements of the User interface. By creating a method in code that performs a logical operation for example. This method can then be assigned to be performed based on a trigger in the user interface, a button press for example.

3.5.1 Coding

Some small samples of code taken from the project are included here. Further examples are shown in Appendix D and a full listing of the code is available of on the attached CD-ROM.

Table 2: Objective-C code examples

Objective C .M file code example:
<code>#import "ThirdDatabaseViewController.h"</code>
<code>@interface ThirdDatabaseViewController ()</code>
<code>@end</code>
<code>@implementation ThirdDatabaseViewController</code>
<code>- (id)initWithNibName:(NSString *)nibNameOrNil bundle:(NSBundle</code>

*)nibNameOrNil
{
self = [super initWithNibName:nibNameOrNil
bundle:nibNameOrNil];
if (self) {
// Custom initialization
}
return self;
}
- (void)viewDidLoad {
[super viewDidLoad];
NSString *docsDir;
NSArray *dirPaths;
Objective-C .H file code example:
#import <UIKit/UIKit.h>
#import <sqlite3.h>
@interface ThirdDatabaseViewController : UIViewController
@property (weak, nonatomic) IBOutlet UITextField *Name;
@property (weak, nonatomic) IBOutlet UITextField *Phone;
@property (weak, nonatomic) IBOutlet UITextField *Address;
@property (strong, nonatomic) NSString *databasePath;
@property (nonatomic) sqlite3 *contactDB;
- (IBAction)findContact:(id)sender;
@end

3.5.2 Databases

When developing applications on iOS there are two main methods that data can be stored and manipulated. The first of these is the proprietary apple framework used for storing data known as “Core Data”. This framework can in fact store data in XML, binary or SQLite stores. This process and any other manipulation of the data are performed using higher-level entities and commands. This is to allow the developer from having to understand the underlying database structure. Core Data is typically used when an application has very large data requirements.

iOS also allows the usage of SQLite this is a lightweight and powerful relational database engine that can easily embed into any application. Given the scope of this project and the small amount of data that needed to be manipulated it was decided to embed the SQLite database into the app rather than using the more heavy weight structures of Core Data. The below sample of code shows a typical call from the application to select data from a table based on a name value input by the user. This is taken from one of the early prototypes used to test the apps database functionality:

Table 3: SQL example

<code>if (sqlite3_open(dbpath, &_contactDB) == SQLITE_OK)</code>
<code>{</code>
<code> NSString *querySQL = [NSString stringWithFormat:</code>
<code> @"SELECT address, phone, id FROM</code>
<code>contacts WHERE name=\"%@\\",</code>
<code> _Name.text];</code>
<code></code>
<code> const char *query_stmt = [querySQL UTF8String];</code>
<code></code>
<code> if (sqlite3_prepare_v2(_contactDB,</code>
<code> query_stmt, -1, &statement,</code>
<code>NULL) == SQLITE_OK)</code>
<code> {</code>
<code> if (sqlite3_step(statement) == SQLITE_ROW)</code>
<code> {</code>
<code> NSString *addressField = [[NSString alloc]</code>
<code> initWithUTF8String:</code>
<code> (const char *)</code>
<code>sqlite3_column_text(</code>
<code>statement, 0)];</code>
<code> _Address.text = addressField;</code>
<code></code>

3.5.3 Scoring

Currently the scoring process for the MPT is performed by entering the data filled in the paper assessment into an excel spread sheet. This sheet is set up so that the data entered is calculated and it can then provide results. Dr. Scherer was kind enough to provide a copy of this spread sheet for this research. A small screen shot of the spread sheet is shown below in figure 3.7.

Page 2 Data Entry Area									
Note: Please enter scores into this spreadsheet in the areas shaded like this :									
Sections A & B: Assistive Technology Device Predisposition Assessment					FORM 4-1		Person		
INITIAL									
Section A Capabilities					Section B Subjective Quality Of Life				
	Question	Enter 1-5	+/-0			Question	Enter 1-5	Importance Rank Top 3	
Seeing	1			Personal care/household activities		10			
Hearing	2			Physical comfort & well-being		11			
Speech	3			Overall health		12			
Understanding/Remembering	4			Freedom to go where desired		13			
Physical Strength/Stamina	5			Participation in desired activities		14			
Lower Body Use	6			Educational attainment		15			
Grasping and Use of Fingers	7			Employment status/potential		16			
Upper Body Use	8			Family relationships		17			
Mobility	9			Close intimate relationships		18			
				Autonomy and self-determination		19			
				Fitting in, belonging, feeling connected		20			
				Emotional well-being		21			

Fig 3.7: Scoring spread sheet

While replicating the entire scoring system was never within the scope of this project. The data that is entered into the app could easily be manipulated to perform the same level of scoring as this spread sheet provides

3.6 Deployment

When developing for iOS, deployment of your application to the inbuilt iOS simulator in Xcode is free of charge. In order to test on a physical device such as an iPhone or iPad however, which was necessary for this project in order to study the accessibility features. A subscription needs to be paid to become a registered Apple developer. This subscription entitles you to access the Apple developer online library and resources and even submit an application to the App Store, although this stage is too outside the scope of this project

While in theory, once this subscription is paid your app can be tested on devices; in practice it is not as simple as this. Any device that you wish to test on needs to be pre registered to your development account, this then allows you to generate a certificate that can be down loaded to you development computer. Once the Xcode IDE recognises the matching certificate and device it will then allow the application to be deployed to the physical device. The device needs to be physically connected by a wire to the development computer for this to happen.

This method of deployment can cause issues with a prototyping methodology, as if deployment is to a number of different test machines it can be tedious to ensure that each machine is up to date with the latest prototype revision. It also rules out the ability to deploy the test application to remote users for testing.

3.7 Challenges

A number of different challenges were experienced during the development process; some of these challenges are detailed below.

3.7.1 Move from iOS 6 to iOS 7

As previously mentioned Apple release their new iOS 7 soft ware during the middle of the development of this application. Due to the increase accessibility features and more attention paid to accessibility in the over all design of the operating system, there was no choice but to continue the development using the new operating system software. A new version of the Xcode IDE was also released at this time to accommodate the new software, this new version had many changes from the previous one and it took a considerable effort in to learn how to use it.

3.7.2 Objective-C

The Objective-C programing language proved to be quite a challenge during the development. It is a complex object orientated language and provided a steep learning curve during the entire process.

3.7.3 Database integration into app

The process of deciding the best method for the app to store data proved to be a challenge. Along with the previously discussed methods of storing data in an app, the process of creating the SQLite instance and populating tables based on user input proved to be difficult.

3.7.4 Accessibility issues

Ensuring that all elements of the prototype adhered to both the guidelines set in chapter 2 and the Apple human interaction guidelines proved difficult. Aspects of this will be reviewed further in the testing chapter.

3.7.5 Deployment issues

Again as was previously discussed, the method in which apps have to be deployed to physical devices was a challenge. In addition to this the process involved in generating the certificates for deployment and the number of issues in general with this process caused a large amount of time to be allocated to something that would be deemed a trivial task. This was indeed a challenge.

3.8 Conclusion

This chapter has looked at the development process of the iOS application. It has covered in depth the platform, the development environment, the user interface aspects of the application, the back end coding and database and the challenges that were associated with the development process. Following this stage a final prototype is now developed testing of this prototype is detailed in the next chapter.

4 TESTING, EXPERIMENTATION AND EVALUATION

4.1 Introduction

This section will look at the testing of the final prototype. In particular it will look at the test methodology in section 4.2; both software and user, it will then look at the testing that was undertaken in section 4.3 and 4.4, again both software and user based testing will be covered.

In addition to testing this chapter will also look at the overall experiment that was firstly proposed and what was in fact performed in this project. An evaluation of the experiment will then be looked at in section 4.5. This evaluation will analyse the findings from the experiment and also discuss any deviation from the proposed experiment. Finally evaluation of the project will be outlined and a conclusion to the chapter is section 4.6 and 4.7.

4.2 Methodology

The testing stage is part of the over all prototyping methodology. Separate methodologies will however be used in this section as the testing process will be broken into two defined paths. These will be testing of the software its self from a purely functional and technological standpoint and usability testing witch will incorporate user testing and accessibility testing.

4.2.1 Software

Software testing is a critical stage of the process. It is in essence an investigation as to the quality of the software and the service it is providing. For this application testing will be performed on the software in a number of ways. These will incorporate both static and dynamic approaches to the software testing. A box testing approach will be conducted on the application along with some destructive testing methods. There are also a number of platform specific testing instruments available in the Xcode IDE that will be used.

4.2.2 User

Because of the nature of this application user testing is just as an important stage in the process. Again user testing will be performed and assessed in a number of different ways. This will make use of the guidelines set out in the background chapter. These will be checked off against how the application performs. The application will then be handed over to a control group a to provide usability testing and feedback. This will be gathered using ethnographic techniques and short user questionnaires.

4.3 *Software testing*

4.3.1 Box testing

Box testing in this case refers to the method of both black box and white box testing. Black box testing refers to high level testing of the application where the tester knows nothing about the inner workings of the application. This kind of testing is quite easy to perform, it provides testing of the functionality of your application but reveals nothing about the inner workings of the code. The black box testing performed on the application final prototype revealed no serious issues with the functionality of the UI.

White box testing is the opposite of black box; it requires knowledge of the underlying system and is designed to test the internal workings and structures of the system. For this application white box test cases were drawn up mostly in relation to the linked database. The white box testing performed on the final prototype revealed no errors in the internal code structures of the application.

4.3.2 Destructive testing

Destructive testing is a method where the tester deliberately attempts to break either a part of the software or the entire application. Destructive testing was performed on these applications again in a number of different ways. Firstly wrongly formatted data was attempted to be inserted into the database. This caused no issue with the running of the application. The design of the application also minimizes the areas in witch a mistake like this could be made by a user.

Unexpectedly closing the application was also attempted this saw no lose of data and the application maintained its position when reopened. Turning off the devise mid application use did indeed cause a loss of data - this result was expected however. Finally, simulated memory warnings were created while running the prototype in the iOS simulator. This provided information on how the application ran when the device was running low on memory. As the application has such a low memory footprint it was able to operate fine under this constraint.

4.3.3 Xcode instruments

The Xcode IDE provides a number of tools called instruments to test software with these include activity monitors memory monitors and memory allocation tools. The output from the running of these tools is shown below with some discussion about each. Each of these results are taken from the final prototype running on an iPad mini device Extracts from the full logs of these tests can also be viewed in Appendix E.

Figure 4.1 shows the output from the memory leaks instrument, this instrument tracks the amount of memory allocated in the upper section. As more features of the application are used you can see that the memory allocation increase. The lower section shows the number of “leaks”. A memory leak is occurs when memory that has been allocated by the program is not de-allocated. Given there is no information showing in the leaks section, all of the memory being used by the application is being allocated and de-allocated correctly.

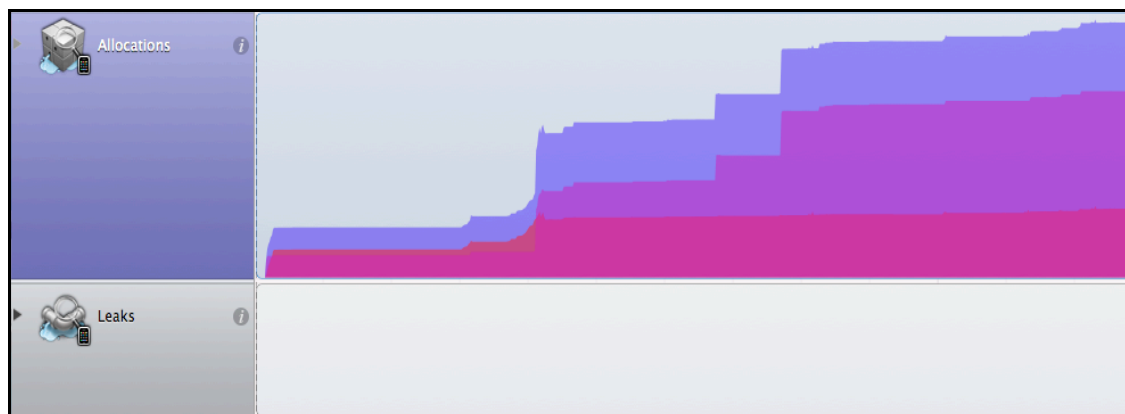


Fig 4.1: Output from Memory leaks instrument

Figure 4.2 shows the output from the memory monitor instrument. This instrument tracks the amount of physical memory that is in use on the device. The green section shows that when the application starts there is a drop in the amount of physical memory left for the device to use. It is important to note that this output gives no representation of the amount that is actually in use or is still freely available on the device. From examination of the logs, it was discovered that the application used in total 17MB of memory, the device has a total 2048MB of available memory.

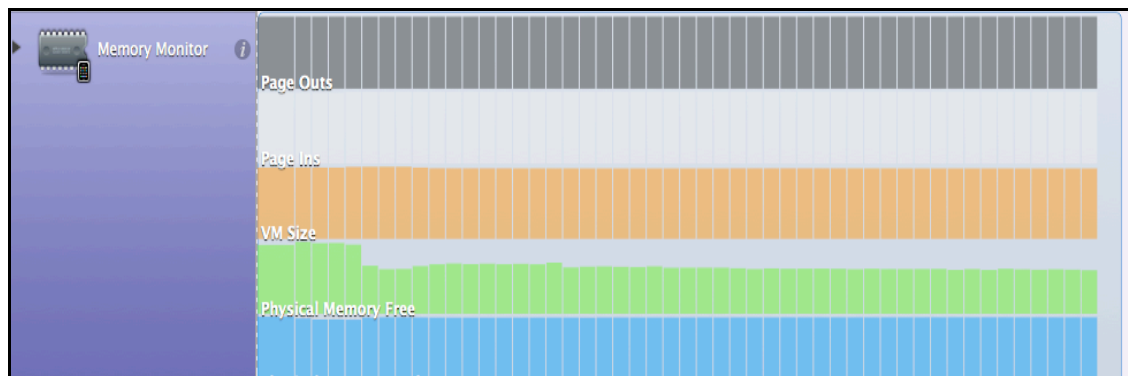


Fig 4.2: Output from Memory monitor instrument

Figure 4.3 shows the activity monitor output; what's being graphed here is the device's CPU usage during the time the application is running. The green and purple sections show user load on the CPU and the total load on the CPU. The reason they correlate directly is because no other application is running on the device at the time. The empty section at the top of the graph shows the overall load on the system, this section is empty because the application does not even use 1% of the system's available CPU.

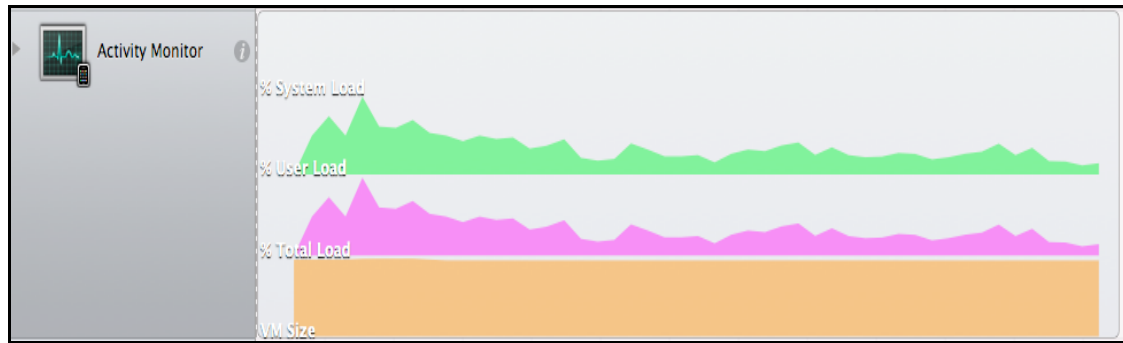


Fig 4.3: output from Activity monitor instrument

The results from these instrument tests are very good, they show that the application is acting as it should in terms of memory and CPU usage and that the application has very little impact of the devices performance.

4.4 User testing

Along with software, testing it is of the utmost importance to test the usability of an application. This is even more important for this application as it is being designed for users with visual impairments. Two separate methods were used in this process; firstly the final prototype was assessed using the set of guidelines set in chapter two. Secondly the application was used by a control group of people without visual impairments in order to gain their feedback on the usability of the application.

4.4.1 Accessibility

Table 4: Accessibility checklist

Universal design:	
Principle 1: Equitable Use	Yes – application incorporates as many accessibility tools as possible to promote equality
Principle 2: Flexibility in Use	Yes
Principle 3: Simple and Intuitive Use	Yes – application is simple to use, intuitive is not entirely applicable as users are guided through the process
Principle 4: Perceptible Information	Yes
Principle 5: Tolerance for Error	Yes – testing has proved this

Principle 6: Low Physical Effort	Yes
Principle 7: Size and Space for Approach and Use	Devices are small and light and can be used in various situations or approaches
W3C WCAG	
Perceivable	Yes
Operable	Yes
Understandable	Yes
Robust	Yes
Application accessibility guidelines	
Ensure that users have access to the operating system accessibility tools, without affecting application functionality.	No – This is not available on the iOS platform
Ensure compatibility with assistive technologies.	Yes
Adhere to all user-selected system settings for input and output.	Yes
Ensure that all information can be perceived by users with restricted or no vision.	Yes
Ensure that all information can be perceived by users with restricted or no hearing.	Yes
Do not cause the screen to flash at a frequency of above 2 Hertz.	Yes
Use the simplest language possible for instructions, prompts and outputs and, where possible, supplement it with pictorial information or spoken language.	Simple language used, No pictorial information.
Provide descriptions and instructions for all accessibility features.	N/A
Provide accessible documentation, training and support materials.	N/A

Allow sufficient response time to accommodate the slowest users.	Yes, No time limits on any section.
Ensure that the user interface and task flow is similar across different functions.	Yes
Adhere to the operating system user interface guidelines.	Yes
Provide accessible packaging, installation and configuration tools.	N/A
Provide for users with multiple impairments.	Not within scope of project

4.4.2 UAT control group

In order to test the usability of the application, the final prototype was presented to a control group for evaluation. These users were asked to complete a section of the MPT assessment on both paper and the electronic format. The control group varied in age from 25 – 54 and had an equal numbers of male and female members. During the tests ethnographic notation was taken. After each user had completed the assessment in both formats they were asked to complete a short questionnaire regarding the tests. A copy of the questionnaire that was given to the users can be found in Appendix J. The key points revealed during the process are listed below:

- Users found the information easier to process in the electronic version of the assessment.
- The paper version was described as “overwhelming” and “busy”.
- Users perceived the time taken to complete the electronic copy to be less.
 - Time taken overall by user was roughly the same for both formats.
- Users sometimes took time to understand the interface when using the electronic assessment.

- This was not the case with the paper assessment.
- Overall users preferred the electronic assessment to the paper assessment.
- Some users found the font on both the electronic and paper assessment to be too small.

4.5 Experimentation

The proposed experiment for this project was to create a mobile digital application of the Matching person and technology assessment. The reasoning for this was to move the MPT assessment into the mobile device realm, services being deployed via mobile apps has become very popular in recent years. The goal was to achieve a more usable solution than the current paper assessment. An assessment that could be completed in less time than the current format.

Could the number of follow up assessments be reduced by deploying in a digital form? Is there a need for a professional to administer the assessment in its mobile form? Could more truthful answers be gathered via a mobile device? In order to achieve this a set of guidelines for accessible app design needed to be researched, as there is no set guidelines or rules for this.

The experiment was to create a prototype app; this app could then be tested in order to help answer some of these questions.

4.6 Evaluation

In order to evaluate the experiment the core questions set out in the introduction chapter will need to be reviewed:

- Is the Mobile application more usable than the paper based method?
 - From the testing completed – yes there are usability advantages to deploying on a digital format. Especially for users who may require AT to perform assessments such as this one.
 - The experiment would benefit from more testing on this area.
- Can the mobile application assessment be completed in a shorter time period than the paper-based method?
 - From testing within the control group there was no obvious time advantage by the digital app over the paper assessment.

- Again the experiment would benefit from further testing in this area, if testing with users who had visual impairments could have been conducted advantages may have been noticed.
- Can the number of follow up assessments be reduced using the mobile application?
 - This point could not be tested during the course of this project. This point will have to be added to the future work section.
- Is there a need for the professional to administer the assessment via the mobile application?
 - From the research conducted it was found that the professional is indeed a key part of the assessment, Regardless of the platform the role of the professional should not be removed from the MPT assessment.
- Can the scoring method become automated using the mobile application?
 - Yes, while the scoring system for the MPT is indeed very complex, when broken down into component piece there is no calculation that could not easily be performed by a mobile device.
- Can better answers be gathered using the mobile application vs. the paper method?
 - This was unable to be tested during the project. This will need to be added to the future work section.
- What is the current state of play for accessible mobile application development?
 - Following research, it was found that no sets of official guidelines or rules exist. Based on accessibility guidelines used elsewhere a set of guidelines was developed for the purpose of this project.

4.7 Expert Feedback

In order to better gauge the outcomes and impact of this research contact was made with Dr Ger Craddock of the National Disability authority. Dr Craddock is a leading expert in the field, He has worked extensively with Dr Scherer, His work is cited on numerous occasions throughout this project. The results, findings and evaluation of the project were presented and some of the feedback is detailed below:

“This work is at the cutting edge of developments in apps in the field of AT both nationally and internationally” – Dr Craddock.

The ability for the assessment to be stopped and started is seen to make the process allowing better interaction between the user and the assessment by Dr Craddock. The automated scoring process was stated to be a key point for future development. The generation of guidelines for mobile development was also highlighted as a key outcome of the research.

Dr Craddock also highlighted an area of ethical concern for using the application with users under the age of 18. A method of promoting interactive features including prompts and potentially avatar-based guidance was also outlined. A full transcript of the feedback from Dr Craddock can be found in Appendix F.

4.8 Conclusion

This chapter reviewed the experiment that was taken on during this project. Looking at each of the main points that were raised in the introduction chapter; each was reviewed. The review of these points is important for the following chapter, as it will help to construct the future work and research section. In addition, this chapter has looked at the testing of the application. This is a critical process, particularly when it comes to AT applications. This chapter outlined the methods that were to be used when testing the application, detailed how this testing was performed and finally what results were recorded from the testing. This stage has created some very important points to carry into the conclusions and future work section.

5 CONCLUSION

5.1 Introduction

Previous to this chapter has been an introduction, a background chapter, a chapter that detailed the development process. After the development was completed there was then a testing chapter, this was then followed by a chapter that reviewed the experimentation and evaluation of the entire project. In this chapter the final conclusions of the research will be drawn, Section 6.2 will give an overview of the research that was conducted. Section 6.3 lists this projects contribution to the body of knowledge. Section 6.4 will then detail any future work and research that has been highlighted by completion of this project.

5.2 Research Overview

In the introduction section research objectives were outlined, these objectives will now be reviewed. The objectives set were:

1. Review current areas of MPT, AT, UD and mobile application design.
2. From research, design suitable prototype.
3. Develop prototype.
4. Perform software and usability testing on prototype.
5. Assess effectiveness of the prototype in relation to the problem areas previously outlined.
6. Document processes, evaluation and conclusions using scientific method.

The outcomes of there are as follows:

1. Each of these areas was researched in detail. The research focused around what aspects of the areas would have an effect on the high level design of the prototype; each area was worked until it became essentially a requirement for the design process.

2. Following the research, the following list of requirements had been outlined. This list made up the high level design of the prototype:
 - a. Ensure the transition from low tech to high tech.
 - b. Involvement by the user in the in the process was identified as a major aspect of the assessment, this must be maintained.
 - c. The assessment process must be quick and simple to complete.
 - d. Feed back from the Screen reader frustration study must be considered during the user interface design.
 - e. The application will be developed as a native app as web apps cannot provide the same functionality and are no longer in popular usage.
 - f. Given the lack of standard accessibility features on Google's android platform and Apples market dominance the development should take place on the Apple iOS platform.
 - g. The methodology that will be used for development should use some form of prototyping, as this will suite the mobile development process well.
 - h. A non-exhaustive set of principles guidelines and rules have been defined to adhere to during the development process. These should also be referred to during any testing phases to monitor the levels at which the end software solution sticks to these.
3. Using these requirements the first prototype was created, this prototype was modified a number of times in order to best meet firstly the high level design in total but then also to adhere to the principles and guidelines for accessible design set out in point h.
4. Software and usability testing was then carried out on the final prototype. While the software testing was completed without issue, in terms of the usability testing it is felt that there is more research o be done. No testing could be performed with users with visual impairments; this would be the logical next stage for usability testing of this application.

5. The effectiveness of the prototype in relation to the problem areas outlines was completed in the previous chapter. This did highlight some key areas of necessary further research. And noted points for the contribution to body of knowledge section also.
6. The project has been documented as best as possible in this document.

5.3 Contributions to the Body of Knowledge

Below, the contributions to the body of knowledge that this project has made are listed:

- A working prototype/example of the MPT assessment was successfully designed developed and deployed as a mobile application.
- Research has been conducted in order to better define a set of guidelines for mobile accessibility.
- Research has shown; that if needed, a mobile device could indeed perform the scoring system of the MPT.
- Clarification that the iOS platform provides a solid development platform for accessible applications.
-

5.4 Future Work & Research

Following this body of research there are several areas of further work and research that could be performed in order to further this research topic.

- Further usability testing needs to be conducted with visually impaired users using the current prototype. This is in order to gain a full understanding of how the applications accessibility features function.
- Further development could be performed to expand the app from its current prototype state to a full representation of the entire MPT assessment.
- Further development in order to implement the automated scoring system on the mobile device could be carried out.
- Should the application ever be proposed for use a very in depth body of research would need to be conducted regarding data protection. Whether keeping personal data on the device or using the Internet to store it elsewhere. There are serious issues that come into play when dealing with personal data and the correct approach would need to be identified.
- Further research into user prompting and avatar-based navigation/guidance in order to promote interactivity with the assessment.

5.5 Conclusion

This project had a goal to create an app. In achieving this goal, several other areas of research were unearthed. This document details the background research thorough to the development an testing phase of the app. Realistically this research is not about the app, it is about the people who might use it, its is about how they interact with it and what they feel when doing so. This research is about taking something that is already good and trying to make it even better, moving it into the modern setting. And ultimately it is about making sure there is equitable use for everyone who may wish to

use it. Doing this was not an easy experience the process was filled with challenges, however these were worthwhile challenges to overcome.

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systems research, systems research in architecture, systems research applications, 1,
p.334.

APPENDIX A

3/9/2014

Gmail - Niall duffy Dit masters student



Niall Duffy <niallduffy1988@gmail.com>

Niall duffy Dit masters student

JSchererer@aol.com <JSchererer@aol.com>
To: niallduffy1988@gmail.com

Thu, Oct 31, 2013 at 1:39 AM

Dear Niall,

I have attached our scoring EXCEL spreadsheet as promised. The procedures and methods for scoring are embedded in the spreadsheet and not documented separately. You will need some experience to understand the EXCEL formulas. John thinks that it will be difficult to translate to an APP, but anything is possible!

Please preserve the paragraphs on the first page that present caveats for the use of the scoring.

Please consult with us when you have completed your work and before you share the APP with others -- that is, please do not release the results for use by others before we review them. Do not share the original EXCEL spreadsheet with anyone.

Regards,
Marcia Scherer, Ph.D.
John Scherer, MSEE
Institute for Matching Person and Technology.

From: niallduffy1988@gmail.com
To: IMPT97@aol.com
Sent: 10/28/2013 11:32:20 A.M. Eastern Daylight Time
Subject: Re: Niall duffy Dit masters stud

Hi Marcia,

It was great to meet you a few weeks ago in Dublin, I found your talk very interesting. I just wanted to keep you up to date with my project regarding the MPT process.

At the moment I am working on a fully accessible 1st prototype of the MPT mobile application, hopefully for the 1st of November. When we spoke in Dublin you mentioned that you would be able to provide me with the scoring method for the process in order to facilitate automated scoring. Would this be possible?

Look forward to hearing from you.

Regards,
Niall Duffy.

On Sun, Sep 1, 2013 at 1:44 PM, niall duffy <niall.duffy@gaa.ie> wrote:

----- Forwarded message -----
From: <IMPT97@aol.com>
Date: Fri, Aug 30, 2013 at 7:30 PM
Subject: Re: Niall duffy Dit masters stud
To: GmCraddock@nda.ie, niall.duffy@gaa.ie

Dear Niall, and Ger,

Attached is the letter giving you permission to use my work, Niall. I am excited about

<https://mail.google.com/mail/u/0/?ui=2&ik=17c886394b&view=pt&q=marcia&qs=true&search=query&msg=1420c2a85242ffaf&siml=1420c2a85242ffaf>

1/3

3/9/2014

Gmail - Re: (no subject)



Niall Duffy <niallduffy1988@gmail.com>

Re: (no subject)

IMPT97@aol.com <IMPT97@aol.com>

Fri, Nov 8, 2013 at 6:27 PM

To: niallduffy1988@gmail.com

Cc: jschererer@aol.com

Hi Niall, and wonderful to hear from you,

I think I would focus initially on people with vision loss. It's easy to either avoid sound or provide text to go along with it. As for mobility, probably the biggest concern would be dexterity and finger control -- solving that is more of a hardware issue in my mind.

When you get your alpha prototype, I can help find people to pilot test it and then we will know how accessible it is.

As for the number of people using Smartphones and iPads, the number is growing every day. In fact, AT industry folks who make specialized products for people with disabilities think they may be out of business in a few years.

Does this help?

Cheers,

Marcia

Marcia J. Scherer, PhD, MPH, FACRM
President
Institute for Matching Person & Technology
486 Lake Road
Webster, NY 14580 USA
585-671-3461 (phone/fax)
<http://matchingpersonandtechnology.com>

Editor, *Disability and Rehabilitation: Assistive Technology*
<http://informahealthcare.com/loi/idt>

Professor of Physical Medicine and Rehabilitation
University of Rochester Medical Center
601 Elmwood Ave., P.O. Box 664
Rochester, NY 14642 USA
http://www.urmc.rochester.edu/web/index.cfm?event=doctor.profile.show&person_id=1001471

Project Director, Center on Effective Rehabilitation Technology (CERT)
Burton Blatt Institute, Syracuse University
<http://bbi.syr.edu/projects/CERT/index.html>

Confidentiality:

The information in this e-mail (including any attachments) may contain confidential information and is intended only for the individual named. If you are not the named addressee you should not disseminate, distribute or copy this email. Please notify the sender immediately by email if you have received this email by mistake and delete this email from your system. Email transmissions cannot be guaranteed to be secure or error free as information could be intercepted, corrupted, lost, destroyed, arrive late or incomplete, or contain viruses. The sender therefore does not accept any liability for errors or omissions in the contents of this message that arise as a result of

<https://mail.google.com/mail/u/0/?ui=2&ik=17c886394b&view=pt&q=marcia&qs=true&search=query&msg=14238f7c5d27f8e4&siml=14238f7c5d27f8e4>

1/2

3/9/2014

Gmail - Fwd: Niall duffy Dit masters stud



Niall Duffy <niallduffy1988@gmail.com>

Fwd: Niall duffy Dit masters stud

3 messages

niall duffy <niall.duffy@gaa.ie>
To: Niall Duffy <niallduffy1988@gmail.com>

Sun, Sep 1, 2013 at 1:44 PM

----- Forwarded message -----
From: <IMPT97@aol.com>
Date: Fri, Aug 30, 2013 at 7:30 PM
Subject: Re: Niall duffy Dit masters stud
To: GMCraddock@nda.ie, niall.duffy@gaa.ie

Dear Niall, and Ger,

Attached is the letter giving you permission to use my work, Niall. I am excited about this!

Best,

Marcia

Marcia J. Scherer, PhD, MPH, FACRM
President
Institute for Matching Person & Technology
486 Lake Road
Webster, NY 14580 USA
585-671-3461 (phone/fax)
<http://matchingpersonandtechnology.com>

Editor, *Disability and Rehabilitation: Assistive Technology*
<http://informahealthcare.com/loi/idt>

Professor of Physical Medicine and Rehabilitation
University of Rochester Medical Center
601 Elmwood Ave., P.O. Box 664
Rochester, NY 14642 USA
http://www.urmc.rochester.edu/web/index.cfm?event=doctor.profile.show&person_id=1001471

Project Director, Center on Effective Rehabilitation Technology (CERT)
Burton Blatt Institute, Syracuse University
<http://bbi.syr.edu/projects/CERT/index.html>

Confidentiality:

The information in this e-mail (including any attachments) may contain confidential information and is intended only for the individual named. If you are not the named addressee you should not disseminate, distribute or copy this email. Please notify the sender immediately by email if you have received this email by mistake and delete this email from your system. Email transmissions cannot be guaranteed to be secure or error free as information could be intercepted, corrupted, lost, destroyed, arrive late or incomplete, or contain viruses. The sender therefore does not accept any liability for errors or omissions in the contents of this message that arise as a result of email transmissions. If verification is required please request a hard copy version

<https://mail.google.com/mail/u/0/?ui=2&ik=17c886394b&view=pt&q=GMCraddock%40nda.ie&q=140d98d8007e3bd6&siml=140d9...> 1/3



The Institute for
Matching
Person & Technology, Inc.

30 August 2013

Niall Duffy
Dublin Institute of Technology
Dublin, Ireland

Dear Niall and To Whom it will Concern:

Thank you for your interest in using the *Matching Person & Technology* model and accompanying measures in your thesis project. I confirm that I own the copyright to these materials.

I ask that you include a brief credit line for what you choose to use from my materials and that a note be included in the acknowledgments. Additionally, I would greatly appreciate receiving a final copy of the material you develop so that I may assist in promoting your work if you so desire.

All best wishes for your success.

Sincerely,

Marcia J. Scherer, Ph.D., MPH
President, Institute for Matching Person & Technology
Professor of Physical Medicine and Rehabilitation, University of Rochester Medical Center
Project Director, Burton Blatt Institute, Syracuse University

486 Lake Road, Webster, NY 14580 • Phone/Fax = 585/671-3461 • Email = IMPT97@aol.com
<http://MatchingPersonandTechnology.com>



APPENDIX B

Samples of MPT assessment

Initial Person	Assistive Technology Device Predisposition Assessment CONSUMER FORM	FORM 4-1 CONSUMER
Name _____ Age _____ Primary Goals (6 months) _____ Today's Date _____ Primary Goals (1 year+) _____ Form completed by _____		
A. How would you rate your abilities today in the following 9 areas when using your current AT or other support?		
<ul style="list-style-type: none"> For items 1-9, mark the best response (1 for <i>poor</i> through 5 for <i>excellent</i>). Under <i>Name of Support</i> write the name of the support you use where relevant (example: 'eyeglasses' for # 1, <i>seeing</i>). Write a plus [+] in the spaces where you expect to need more support over the next year (example: 'eyeglasses' gets [+] if you'll expect to need stronger lenses during the next year). Write a [-] in the spaces where you expect to need less support, and a [0] where you expect your support should stay the same over the next year. 		
	Poor Average Excellent	Name of Support Need more [+], less [-], same [0]
1. Seeing	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	_____
2. Hearing	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	_____
3. Speech	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	_____
4. Understanding, remembering	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	_____
5. Physical strength/stamina	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	_____
6. Lower body use (hips, legs, feet)	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	_____
7. Grasping and use of fingers	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	_____
8. Upper body use (arms, shoulders, trunk)	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	_____
9. Mobility (getting from place to place)	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	_____
B. How satisfied are you currently in the following areas?		
<ul style="list-style-type: none"> For items 10 – 21, mark the best response (1 for <i>Not Satisfied</i> through 5 for <i>Very Satisfied</i>). Which 3 items are most important to you? Under <i>3 Most Important</i>, write #1, #2 or #3 for the three areas that concern you most (#1=most important). Leave the other lines blank. For your <i>3 Most Important</i> items, write the primary obstacles and barriers you face in the space beside that item 		
	Not Satisfied Satisfied Very Satisfied 3 Most Important	
10. Personal care and household activities	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	_____
11. Physical comfort & well-being	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	_____
12. Overall health	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	_____
13. Freedom to go wherever desired	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	_____
14. Participation in desired activities	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	_____
15. Educational attainment	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	_____
16. Employment status/potential	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	_____
17. Family relationships	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	_____
18. Close, intimate relationships	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	_____
19. Autonomy and self-determination (choosing)	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	_____
20. Fitting in, belonging, feeling connected	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	_____
21. Emotional well-being	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	_____
C. Please mark all the statements below that describe you. Mark only those that <i>frequently or often</i> apply to you and ignore those that very <i>rarely or never</i> apply to you.		
<input type="checkbox"/> 22. I have the support I want from family <input type="checkbox"/> 23. I have the support I want from friends <input type="checkbox"/> 24. I feel encouraged by therapists, caregivers <input type="checkbox"/> 25. I feel the general public accepts me <input type="checkbox"/> 26. I aspire to go to school or work <input type="checkbox"/> 27. I have many things I want to accomplish	<input type="checkbox"/> 33. I am usually calm and patient <input type="checkbox"/> 34. My life has purpose, meaning <input type="checkbox"/> 35. I am self-disciplined <input type="checkbox"/> 36. I am often angry <input type="checkbox"/> 37. I am often depressed <input type="checkbox"/> 38. I prefer to be left alone	<input type="checkbox"/> 44. I find technology interesting <input type="checkbox"/> 45. I am cooperative <input type="checkbox"/> 46. I prefer a quiet lifestyle <input type="checkbox"/> 47. I often feel isolated & alone <input type="checkbox"/> 48. I accomplish what I set out to do <input type="checkbox"/> 49. I am not sure who I am now

Name: _____ Today's Date: _____ Form completed by: _____

In which areas does the person (a) use, (b) have past use, and (c) need a technology or other support? Write the name of the support in each relevant domain, and then record the information requested under the one most appropriate column.

Name of Support Used	SUPPORT CURRENTLY USED			SUPPORT USED IN THE PAST (not listed under currently used)			SUPPORT NEEDED			
	Months Used	% of Day Used	Satisfaction with support (1=very dissatisfied, 3=neutral, 5=very satisfied)	Months Used	% of Day Used	Satisfaction with support (1=very dissatisfied, 3=neutral, 5=very satisfied)	Reason for No Longer Using	Need and Want but Does Not Have	Need but Does Not Want	Reason
Speech/communication										
1.										
2.										
3.										
Mobility										
1.										
2.										
3.										
Dexterity, hand use										
1.										
2.										
3.										
Seeing										
1.										
2.										
3.										

A Survey for Employees, Students and Others Learning a New Technology for a Job

Employee Name _____ Today's Date _____ Form completed by _____

Technology _____

Employees who feel anxious or uncomfortable with a new technology cannot use that technology in a manner beneficial to themselves, the company or institution. This form will assist you in identifying areas that may affect your acceptance or use of a new technology in the workplace. This form can be used together with the companion *Employer Form*.

The Technology Itself

Not at All Somewhat Definitely

Is the technology useable with little or no discomfort stress or fatigue?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Is the time needed for practice and training reasonable?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Do you think mastering the technology will help you succeed?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Do you think mastering the technology will help you in the eyes of your peers and supervisors?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Are you able to adjust the technology to meet your preferences and requirements?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Will you have a backup technology or support if needed?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5***The Person Who Will Use the Technology***

Not at All Somewhat Definitely

Are you comfortable advocating your technology needs in this workplace?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Have you had previous success with new technology in this work environment?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Do you have control over how quickly the technology will be acquired and installed?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Do you have the skills needed to use this new technology?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Do you feel that the technology will assist you to fit in and belong in this workplace?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Are you satisfied with your career and job?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Do you have what you need to do your job effectively?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Are your relationships with co-workers generally positive?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Are your relationships with your supervisor/employer generally positive?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Are you generally working at your potential?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Student's Name _____ Educational Goal _____
 Technology _____ Today's Date _____

A. EDUCATIONAL GOAL

- | | No | | Somewhat | | Yes |
|--|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| 1. Do you understand the goal that is written above? | <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 |
| 2. Do you agree that this is a goal you need to achieve? | <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 |
| 3. Do you feel you <u>can</u> achieve this goal? | <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 |
| 4. Do you <u>want</u> to achieve this goal? | <input type="checkbox"/> 1 | <input type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5 |

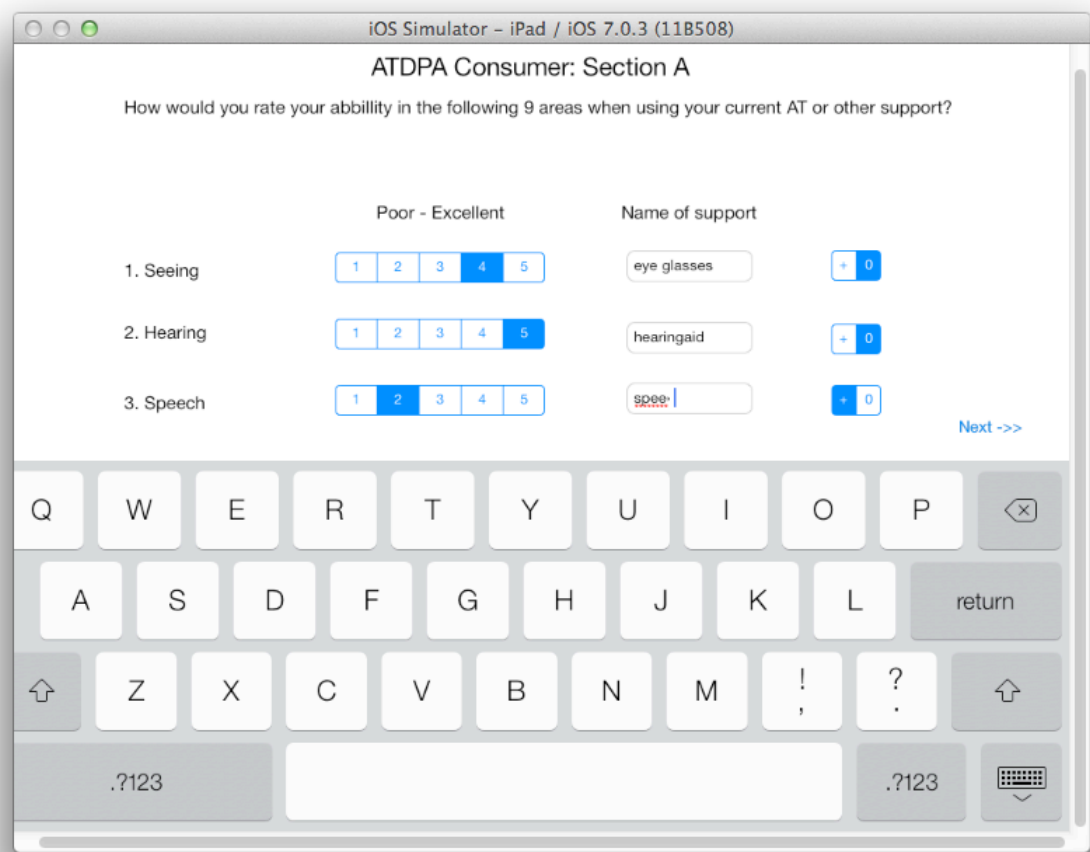
B. THE STUDENT

Check the box of each statement below that describes you.

- | | | |
|---|--|---|
| 1. <input type="checkbox"/> I am curious & excited about new things | 10. <input type="checkbox"/> I have the background skills and knowledge for what I need to learn | 21. <input type="checkbox"/> I am usually flexible/adaptable |
| 2. <input type="checkbox"/> I am impatient | 11. <input type="checkbox"/> I have physical or sensory limitations | 22. <input type="checkbox"/> I sometimes need frequent feedback |
| 3. <input type="checkbox"/> I receive criticism well | 12. <input type="checkbox"/> I sometimes need frequent reinforcement | 23. <input type="checkbox"/> I sometimes feel intimidated by technology |
| 4. <input type="checkbox"/> I move from task to task easily | 13. <input type="checkbox"/> My physical dexterity is good | 24. <input type="checkbox"/> I am often easily distracted |
| 5. <input type="checkbox"/> I like to have the teacher's full attention | 14. <input type="checkbox"/> I feel confident | 25. <input type="checkbox"/> I usually accept my teachers' advice |
| 6. <input type="checkbox"/> I work carefully | 15. <input type="checkbox"/> I like to try new things | 26. <input type="checkbox"/> I am often easily bored |
| 7. <input type="checkbox"/> I have the intellectual abilities required for what I need to learn | 16. <input type="checkbox"/> I would describe myself as studious | 27. <input type="checkbox"/> I often feel anxious |
| 8. <input type="checkbox"/> I want to control my own learning pace | 17. <input type="checkbox"/> I often want to work slower/faster than others | 28. <input type="checkbox"/> I have a cooperative attitude |
| 9. <input type="checkbox"/> I sometimes think too much about my limitations | 18. <input type="checkbox"/> I am sometimes critical | 29. <input type="checkbox"/> Most of the time I am prepared for class |
| | 19. <input type="checkbox"/> I prefer to work in a group rather than by myself | 30. <input type="checkbox"/> I work with precision |
| | 20. <input type="checkbox"/> I like using a computer | 31. <input type="checkbox"/> I prefer getting feedback from a computer than from my teacher |
| | | 32. <input type="checkbox"/> I am motivated to learn |

APPENDIX C

Screen shots of application user interface



iOS Simulator - iPad / iOS 7.0.3 (11B508)

ATDPA Consumer: Section A

How would you rate your ability in the following 9 areas when using your current AT or other support?

	Poor - Excellent	Name of support	
4. Understanding and Remembering	<div><div>1</div><div>2</div><div>3</div><div>4</div><div>5</div></div>	<input type="text"/>	<div>+0</div>
5. Physical Streangth	<div><div>1</div><div>2</div><div>3</div><div>4</div><div>5</div></div>	<input type="text"/>	<div>+0</div>
6. Lower body use	<div><div>1</div><div>2</div><div>3</div><div>4</div><div>5</div></div>	<input type="text"/>	<div>+0</div>

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Next >>

Q W E R T Y U I O P

A S D F G H J K L return

Z X C V B N M ! , ?

.?123 .?123

APPENDIX D

Code examples

****Example from early prototype created in November 2013****

```
//
// DatabaseViewController.m
// Database
//
// Created by niall duffy on 03/11/2013.
// Copyright (c) 2013 niall duffy. All rights reserved.
//

#import "DatabaseViewController.h"

@interface DatabaseViewController ()

@end

@implementation DatabaseViewController

- (void)viewDidLoad {
    [super viewDidLoad];
    NSString *docsDir;
    NSArray *dirPaths;

    // Get the documents directory
    dirPaths = NSSearchPathForDirectoriesInDomains(
NSDocumentDirectory, NSUserDomainMask, YES);

    docsDir = dirPaths[0];

    // Build the path to the database file
    _databasePath = [[NSString alloc]
initWithString: [docsDir
stringByAppendingPathComponent:
@"contacts.db"]];

    NSFileManager *filemgr = [NSFileManager defaultManager];

    if ([filemgr fileExistsAtPath: _databasePath] == NO)
    {
        const char *dbpath = [_databasePath UTF8String];

        if (sqlite3_open(dbpath, &_contactDB) == SQLITE_OK)
        {
            char *errMsg;
            const char *sql_stmt =
"CREATE TABLE IF NOT EXISTS CONTACTS (ID INTEGER
PRIMARY KEY AUTOINCREMENT, NAME TEXT, ADDRESS TEXT, PHONE TEXT,
```

```

BEER TEXT)";

        if (sqlite3_exec(_contactDB, sql_stmt, NULL, NULL,
&errMsg) != SQLITE_OK)
        {
            _Status.text = @"Failed to create table";
        }
        sqlite3_close(_contactDB);
    } else {
        _Status.text = @"Failed to open/create database";
    }
}

- (void) saveData:(id)sender
{
    sqlite3_stmt *statement;
    const char *dbpath = [_databasePath UTF8String];

    if (sqlite3_open(dbpath, &_contactDB) == SQLITE_OK)
    {
        NSString *insertSQL = [NSString stringWithFormat:
@"INSERT INTO CONTACTS (name,
address, phone, beer) VALUES (\\%@\\", \\%@\\", \\%@\\", \\%@\\")",
_Name.text, _Address.text,
_Phone.text, _Beer.text];

        const char *insert_stmt = [insertSQL UTF8String];
        sqlite3_prepare_v2(_contactDB, insert_stmt,
-1, &statement, NULL);
        if (sqlite3_step(statement) == SQLITE_DONE)
        {
            _Status.text = @"Contact added";
            _Name.text = @"";
            _Address.text = @"";
            _Phone.text = @"";
            _Beer.text = @"";
        } else {
            _Status.text = @"Failed to add contact";
        }
        sqlite3_finalize(statement);
        sqlite3_close(_contactDB);
    }
}

- (void) findContact:(id)sender
{
    const char *dbpath = [_databasePath UTF8String];
    sqlite3_stmt *statement;

    if (sqlite3_open(dbpath, &_contactDB) == SQLITE_OK)
    {
        NSString *querySQL = [NSString stringWithFormat:

```

```

        @"SELECT address, phone, beer, id
FROM contacts WHERE name=\"%@"",
        _Name.text];

    const char *query_stmt = [querySQL UTF8String];

    if (sqlite3_prepare_v2(_contactDB,
                           query_stmt, -1, &statement,
NULL) == SQLITE_OK)
    {
        if (sqlite3_step(statement) == SQLITE_ROW)
        {
            NSString *addressField = [[NSString alloc]
                                      initWithUTF8String:
                                      (const char *)
sqlite3_column_text(
statement, 0)];
            _Address.text = addressField;

            NSString *phoneField = [[NSString alloc]
                                    initWithUTF8String:(const char *)
sqlite3_column_text(statement, 1)];
            _Phone.text = phoneField;

            NSString *beerField = [[NSString alloc]
                                   initWithUTF8String:(const char *)
sqlite3_column_text(statement, 2)];
            _Beer.text = beerField;

            _Status.text = @"Match found";
        } else {
            _Status.text = @"Match not found";
            _Address.text = @"";
            _Phone.text = @"";
            _Beer.text = @"";
        }
        sqlite3_finalize(statement);
    }
    sqlite3_close(_contactDB);
}

- (void)didReceiveMemoryWarning
{
    [super didReceiveMemoryWarning];
    // Dispose of any resources that can be recreated.
}

```

```

- (void) testfunction:(id)sender
{
    NSString *test = @"ahhhh lad";
    _Status.text = (test);

}

@end


//
//  ThirdDatabaseViewController.m
//  Database
//
//  Created by niall duffy on 04/11/2013.
//  Copyright (c) 2013 niall duffy. All rights reserved.
//

#import "ThirdDatabaseViewController.h"

@interface ThirdDatabaseViewController ()

@end

@implementation ThirdDatabaseViewController

- (id)initWithNibName:(NSString *)nibNameOrNil bundle:(NSBundle *)nibBundleOrNil
{
    self = [super initWithNibName:nibNameOrNil bundle:nibBundleOrNil];
    if (self) {
        // Custom initialization
    }
    return self;
}

- (void)viewDidLoad {
    [super viewDidLoad];
    NSString *docsDir;
    NSArray *dirPaths;

    // Get the documents directory
    dirPaths = NSSearchPathForDirectoriesInDomains(
        NSDocumentDirectory, NSUserDomainMask, YES);

    docsDir = dirPaths[0];

```

```

        // Build the path to the database file
        _databasePath = [[NSString alloc]
                        initWithString: [docsDir
stringByAppendingPathComponent:
                                @"contacts.db"]];

    NSFileManager *filemgr = [NSFileManager defaultManager];

    if ([filemgr fileExistsAtPath: _databasePath ] == NO)
    {
        const char *dbpath = [_databasePath UTF8String];

        if (sqlite3_open(dbpath, &_contactDB) == SQLITE_OK)
        {
            char *errMsg;
            const char *sql_stmt =
                "CREATE TABLE IF NOT EXISTS CONTACTS (ID INTEGER
PRIMARY KEY AUTOINCREMENT, NAME TEXT, ADDRESS TEXT, PHONE
TEXT)";

            if (sqlite3_exec(_contactDB, sql_stmt, NULL, NULL,
&errMsg) != SQLITE_OK)
            {
                }
                sqlite3_close(_contactDB);
            } else {
                }
            }
        }
    }

- (void) findContact:(id)sender
{
    const char *dbpath = [_databasePath UTF8String];
    sqlite3_stmt *statement;

    if (sqlite3_open(dbpath, &_contactDB) == SQLITE_OK)
    {
        NSString *querySQL = [NSString stringWithFormat:
                                @"SELECT address, phone FROM
contacts WHERE name=\"%@\"",
                                _Name.text];

        const char *query_stmt = [querySQL UTF8String];

        if (sqlite3_prepare_v2(_contactDB,
                                query_stmt, -1, &statement,
NULL) == SQLITE_OK)
        {
            if (sqlite3_step(statement) == SQLITE_ROW)
            {

```

```

        NSString *addressField = [[NSString alloc]
                                   initWithUTF8String:
                                   (const char *)
sqlite3_column_text(
statement, 0)];
        //_Address.text = addressField;
        NSString *phoneField = [[NSString alloc]
initWithUTF8String:(const char *)
sqlite3_column_text(statement, 1)];
        _Phone.text = phoneField;
        // _Address2.text = addressField;
        // _Status.text = @"Match found";
        _Address.text = addressField;
    } else {
        //_Status.text = @"Match not found";
        //_Address.text = @"";
        //_Phone.text = @"";
    }
    sqlite3_finalize(statement);
}
sqlite3_close(_contactDB);
}

- (void)didReceiveMemoryWarning
{
    [super didReceiveMemoryWarning];
    // Dispose of any resources that can be recreated.
}

@end

```

APPENDIX E

Extracts from testing logs

Memory allocations/leaks output:

Graph	Category	Live Bytes	# Living	# Transient	Overall Bytes	#
OverallBytes Allocated (Net / Overall)						
1	All Heap & Anonymous VM	8.29 MB	34179	106389	23.46 MB	
	140568	<XRRatioObject: 0x7ff3e8090ea0> %0.12, %0.22				
1	All Heap Allocations	2.23 MB	34053	106252	12.46 MB	
	140305	<XRRatioObject: 0x7ff3e8090ea0> %0.03, %0.15				
1	All Anonymous VM	6.06 MB	126	137	11.00 MB	263
	<XRRatioObject: 0x7ff3e8090ea0> %0.09, %0.07					
0	VM: CG raster data	3.27 MB	39	2	3.30 MB	41
	<XRRatioObject: 0x7ff3e8090ea0> %0.05, %0.00					
0	VM: UIKBDimmingView (CALayer)			1.38 MB	1	0 1.38
MB	1	<XRRatioObject: 0x7ff3e8090ea0> %0.02, %0.00				
0	VM: Dispatch continuations	512.00 KB	1	0	512.00 KB	1
	<XRRatioObject: 0x7ff3e8090ea0> %0.01, %0.00					
0	VM: CoreAnimation	216.00 KB	40	22	304.00 KB	62
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	VM: UITextField (CALayer)	200.00 KB	15	0	200.00 KB	15
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	Malloc 2.00 KB	160.00 KB	80	78	316.00 KB	158
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	Malloc 16 Bytes	147.45 KB	9437	21021	475.91 KB	30458
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	Malloc 1.00 KB	144.00 KB	144	705	849.00 KB	849
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.01					
0	Malloc 2.50 KB	135.00 KB	54	25	197.50 KB	79
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	VM: Allocation	128.00 KB	128.00 KB	1	0	128.00 KB 1
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	VM: UILabel (CALayer)	128.00 KB	12	3	188.00 KB	15
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					

0	Malloc 144 Bytes	84.23 KB	599	870	206.58 KB	1469
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	Malloc 1.50 KB	84.00 KB	56	141	295.50 KB	197
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	Malloc 32 Bytes	82.84 KB	2651	4435	221.44 KB	7086
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	sfnt_name_t	77.59 KB	809	0	77.59 KB	809
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	CFString (immutable)	77.08 KB	2068	6645	306.80 KB	8713
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	Malloc 4.50 KB	67.50 KB	15	2	76.50 KB	17
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	VM: CoreUI image data	64.00 KB	2	6	88.00 KB	8
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	Malloc 64.00 KB	64.00 KB	1	9	640.00 KB	10
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.01					
0	Malloc 48 Bytes	57.00 KB	1216	1375	121.45 KB	2591
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	Malloc 8.00 KB	56.00 KB	7	10	136.00 KB	17
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	CFBasicHash (value-store)	53.62 KB	694	2340	180.11 KB	3034
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	CFBasicHash (key-store)	50.16 KB	646	1416	139.23 KB	2062
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	VM: UITextFieldLabel (CALayer)	48.00 KB	4	0	48.00 KB	4
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	Malloc 272 Bytes	45.16 KB	170	122	77.56 KB	292
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	Malloc 160 Bytes	40.31 KB	258	1354	251.88 KB	1612
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	Malloc 80 Bytes	36.72 KB	470	1108	123.28 KB	1578
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	VM: Allocation	32.00 KB	32.00 KB	1	0	32.00 KB
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	VM: UITextMagnifierRangedRenderer (CALayer)	32.00 KB	1	1		

	64.00 KB	2	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00			
0	Malloc 64 Bytes	28.88 KB	462	1326	111.75 KB	1788
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	Malloc 4.00 KB	28.00 KB	7	362	1.44 MB	369
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.02					
0	CFData	27.17 KB	142	737	62.56 KB	879
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	CFDictionary (mutable)	26.91 KB	574	674	58.50 KB	
	1248	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00				
0	__NSArrayM	25.34 KB	811	3280	127.84 KB	4091
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	VM: UILabel (CALayer)	24.00 KB	3	1	32.00 KB	
	4	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00				
0	VM: _UITextFieldContentView (CALayer)	24.00 KB	2	7		
	108.00 KB	9	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00			
0	Malloc 7.50 KB	22.50 KB	3	21	180.00 KB	24
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	CGDataProvider	20.95 KB	149	27	24.75 KB	176
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	CGImage	20.62 KB	165	27	24.00 KB	192
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	CSIDData	20.61 KB	18	0	20.61 KB	18
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	VM: Allocation	20.00 KB	20.00 KB	1	0	20.00 KB
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	Malloc 8 Bytes	19.34 KB	2476	4518	54.64 KB	6994
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	CALayer	18.00 KB	384	301	32.11 KB	685
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	Malloc 8.50 KB	17.00 KB	2	89	773.50 KB	91
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.01					
0	VM: Allocation	16.00 KB	16.00 KB	1	2	48.00 KB
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					
0	Malloc 16.00 KB	16.00 KB	1	1	32.00 KB	2
	<XRRatioObject: 0x7ff3e8090ea0> %0.00, %0.00					

307	DTMobileIS	root	19.2	6	3.38 MB	47.23 MB	ARM
28	backboardd	mobile	3.5	15	14.47 MB	164.76 MB	ARM
46	mediaserverd	mobile	0.4	22	4.95 MB	76.55 MB	ARM
1	launchd	root	0	3	980.00 KB	20.66 MB	ARM
14	UserEventAgent	root	0	12	3.05 MB	48.56 MB	ARM
15	wifid	root	0	5	2.47 MB	44.81 MB	ARM
18	timed	mobile	0	3	1.71 MB	43.56 MB	ARM
21	mediaremotd	mobile	0	4	1.57 MB	21.47 MB	ARM
24	iaptransportd	mobile	0	2	1.12 MB	43.23 MB	ARM
27	softwareupd...	mobile	0	2	996.00 KB	20.12 MB	ARM
29	sharingd	mobile	0	2	2.84 MB	43.90 MB	ARM
32	mDNSRespo...	_mdnsresp...	0	3	1.52 MB	21.34 MB	ARM
33	SpringBoard	mobile	0	11	32.36 MB	170.32 MB	ARM
34	routined	mobile	0	2	1.47 MB	43.24 MB	ARM
35	softwarebeh...	mobile	0	3	1.04 MB	43.43 MB	ARM
38	aggregated	mobile	0	6	3.28 MB	45.10 MB	ARM
42	syslogd	root	0	5	672.00 KB	22.21 MB	ARM
43	aosnotifyd	mobile	0	4	2.32 MB	45.14 MB	ARM
44	CommCente...	_wireless	0	7	2.13 MB	27.18 MB	ARM
45	keybagd	root	0	4	620.00 KB	21.62 MB	ARM
47	powerd	root	0	2	772.00 KB	42.92 MB	ARM
49	ubd	mobile	0	10	3.00 MB	53.42 MB	ARM
52	lockdownd	root	0	2	1.83 MB	43.42 MB	ARM
53	locationd	root	0	11	6.86 MB	55.22 MB	ARM
54	fairplayd.A2	mobile	0	2	1.71 MB	28.54 MB	ARM
56	identityservices	mobile	0	4	3.05 MB	44.27 MB	ARM
57	configd	root	0	10	2.62 MB	47.61 MB	ARM
58	imagent	mobile	0	2	2.12 MB	42.99 MB	ARM
61	BTSerVer	mobile	0	10	2.30 MB	49.40 MB	ARM
62	installd	mobile	0	2	1.67 MB	21.19 MB	ARM
63	fseventsd	root	0	4	896.00 KB	21.27 MB	ARM
65	wirelessproxd	mobile	0	2	1.54 MB	43.07 MB	ARM
66	AppleIDAuth...	root	0	3	1.10 MB	21.40 MB	ARM
70	sandboxd	root	0	2	916.00 KB	29.14 MB	ARM
71	notifyd	root	0	3	840.00 KB	21.14 MB	ARM
73	lsd	mobile	0	2	1.53 MB	43.48 MB	ARM
74	xpcd	mobile	0	3	912.00 KB	21.11 MB	ARM
75	distnoted	root	0	3	684.00 KB	43.36 MB	ARM
76	MobileGestal...	mobile	0	2	1.38 MB	20.18 MB	ARM
77	securityd	_securityd	0	5	2.82 MB	46.44 MB	ARM
78	BlueTool	mobile	0	2	908.00 KB	24.31 MB	ARM
79	networkd	_networkd	0	2	2.73 MB	43.82 MB	ARM
80	networkd_pr...	root	0	2	456.00 KB	20.59 MB	ARM
81	CloudKeycha...	root	0	2	1,000.00 KB	20.13 MB	ARM
82	accounts	mobile	0	2	2.88 MB	43.31 MB	ARM
84	apsd	mobile	0	6	3.59 MB	45.68 MB	ARM
87	DuetLST	mobile	0	2	2.49 MB	43.64 MB	ARM
89	storebookke...	mobile	0	2	1.70 MB	43.66 MB	ARM
90	itunescloudd	mobile	0	5	3.23 MB	45.35 MB	ARM
91	itunesstored	mobile	0	6	5.50 MB	48.88 MB	ARM
93	medialibraryd	mobile	0	2	2.01 MB	43.55 MB	ARM
94	CMFSyncAgent	mobile	0	2	1,016.00 KB	20.09 MB	ARM
96	dataaccessd	mobile	0	8	4.89 MB	46.91 MB	ARM
97	IMDPersisten...	mobile	0	3	2.28 MB	53.00 MB	ARM
100	com.apple.M...	root	0	2	992.00 KB	20.61 MB	ARM
101	xpcd	root	0	2	820.00 KB	20.60 MB	ARM
103	tccd	mobile	0	2	1.07 MB	20.80 MB	ARM
106	BTLEServer	mobile	0	2	1.10 MB	20.19 MB	ARM
110	touchsetupd	mobile	0	2	1.38 MB	42.94 MB	ARM
112	MobileMail	mobile	0	12	15.02 MB	125.32 MB	ARM
114	softwareupd...	mobile	0	3	2.26 MB	43.50 MB	ARM
115	Facebook	mobile	0	5	8.70 MB	80.18 MB	ARM

80	networkd...	root	0	2	456.00 KB	20.59 MB	ARM
295	coresymb...	root	0	2	488.00 KB	21.61 MB	ARM
141	syslog_relay	mobile	0	4	512.00 KB	21.59 MB	ARM
257	absd	mobile	0	2	520.00 KB	20.59 MB	ARM
164	afcd	mobile	0	3	540.00 KB	20.65 MB	ARM
45	keybagd	root	0	4	620.00 KB	21.62 MB	ARM
42	syslogd	root	0	5	672.00 KB	22.21 MB	ARM
75	distnoted	root	0	3	684.00 KB	43.36 MB	ARM
47	powerd	root	0	2	772.00 KB	42.92 MB	ARM
101	xpcd	root	0	2	820.00 KB	20.60 MB	ARM
71	notifyd	root	0	3	840.00 KB	21.14 MB	ARM
123	adid	mobile	0	2	896.00 KB	21.05 MB	ARM
63	fseventsd	root	0	4	896.00 KB	21.27 MB	ARM
78	BlueTool	mobile	0	2	908.00 KB	24.31 MB	ARM
129	com.apple...	root	0	2	912.00 KB	20.36 MB	ARM
74	xpcd	mobile	0	3	912.00 KB	21.11 MB	ARM
70	sandboxd	root	0	2	916.00 KB	29.14 MB	ARM
1	launchd	root	0	3	980.00 KB	20.66 MB	ARM
100	com.apple...	root	0	2	992.00 KB	20.61 MB	ARM
27	softwareu...	mobile	0	2	996.00 KB	20.12 MB	ARM
81	CloudKeyc...	root	0	2	1,000.00 KB	20.13 MB	ARM
94	CMFSyncA...	mobile	0	2	1,016.00 KB	20.09 MB	ARM
35	softwareb...	mobile	0	3	1.04 MB	43.43 MB	ARM
142	notificatio...	mobile	0	2	1.04 MB	20.58 MB	ARM
103	tccd	mobile	0	2	1.07 MB	20.80 MB	ARM
106	BTLEServer	mobile	0	2	1.10 MB	20.19 MB	ARM
66	AppleIDA...	root	0	3	1.10 MB	21.40 MB	ARM
24	iaptransp...	mobile	0	2	1.12 MB	43.23 MB	ARM
232	EscrowSec...	mobile	0	2	1.14 MB	42.95 MB	ARM
175	filecoordi...	root	0	3	1.24 MB	21.70 MB	ARM
154	geod	mobile	0	2	1.26 MB	42.87 MB	ARM
76	MobileGes...	mobile	0	2	1.38 MB	20.18 MB	ARM
110	touchsetupd	mobile	0	2	1.38 MB	42.94 MB	ARM
34	routined	mobile	0	2	1.47 MB	43.24 MB	ARM
32	mDNSRes...	_mdnsresp...	0	3	1.52 MB	21.34 MB	ARM
73	lsd	mobile	0	2	1.53 MB	43.48 MB	ARM
65	wirelesspr...	mobile	0	2	1.54 MB	43.07 MB	ARM
21	mediarem...	mobile	0	4	1.57 MB	21.47 MB	ARM
143	mobile_in...	mobile	0	2	1.66 MB	43.95 MB	ARM
62	installd	mobile	0	2	1.67 MB	21.19 MB	ARM
207	calaccessd	mobile	0	2	1.70 MB	43.54 MB	ARM
89	storebook...	mobile	0	2	1.70 MB	43.66 MB	ARM
54	fairplayd.A2	mobile	0	2	1.71 MB	28.54 MB	ARM
18	timed	mobile	0	3	1.71 MB	43.56 MB	ARM
205	recentsd	mobile	0	3	1.76 MB	43.80 MB	ARM
52	lockdownd	root	0	2	1.83 MB	43.42 MB	ARM
156	librariand	mobile	0	3	1.83 MB	44.05 MB	ARM
93	medialibr...	mobile	0	2	2.01 MB	43.55 MB	ARM
119	assetsd	mobile	0	2	2.05 MB	43.41 MB	ARM
308	cplogd	mobile	0	2	2.06 MB	43.36 MB	ARM
58	imagent	mobile	0	2	2.12 MB	42.99 MB	ARM
44	CommCen...	_wireless	0	7	2.13 MB	27.18 MB	ARM
114	softwareu...	mobile	0	3	2.26 MB	43.50 MB	ARM
97	IMDPersist...	mobile	0	3	2.28 MB	53.00 MB	ARM
61	BTServer	mobile	0	10	2.30 MB	49.40 MB	ARM
43	aosnotifyd	mobile	0	4	2.32 MB	45.14 MB	ARM
15	wifid	root	0	5	2.47 MB	44.81 MB	ARM
87	DuetLST	mobile	0	2	2.49 MB	43.64 MB	ARM
57	configd	root	0	10	2.62 MB	47.61 MB	ARM
79	networkd	_networkd	0	2	2.73 MB	43.82 MB	ARM
118	mobileassetd	root	0	4	2.79 MB	46.02 MB	ARM
77	securityd	_securityd	0	5	2.82 MB	46.44 MB	ARM

APPENDIX F

5/21/2014

Gmail - Feedback



Niall Duffy <niallduffy1988@gmail.com>

Feedback

Gerald M. Craddock <GMCraddock@nda.ie>
To: Niall Duffy <niallduffy1988@gmail.com>

Tue, May 20, 2014 at 9:48 PM

See comments below. Hi Niall see what you think. If you need something else I am up for another hour or more. Send text to mobile for me to check mail.
Great questions below
Best of luck
Gc

Sent from my iPad

On 20 May 2014, at 20:02, "Niall Duffy" <niallduffy1988@gmail.com> wrote:

Sorry - Now attached

The q&a are were points set out at the start of the process and then reviewed at the end.

So you took elements of the mpt or all of the mpt and put into an app --> Not all of it, enough for Proof of concept and usability testing
Did you use prompts to direct them? Them being professionals or users or both? -->> *App can utilize the voice over feature of iOS allowing audio description or prompt for any UI element.*
Did you test with people and who? -->> *Only tested with control group(no visual impairment), Further testing highlighted in future work.*

On Tue, May 20, 2014 at 7:44 PM, Gerald M. Craddock <GMCraddock@nda.ie> wrote:

Hi Niall
No screen shots attached? So you took elements of the mpt or all of the mpt and put into an app?
Did you use prompts to direct them? Them being professionals or users or both?
Did you test with people and who?
These would help in commenting on your question and answer.
To clarify you want me to comment on the q&a?
Gc

Sent from my iPad

On 15 May 2014, at 23:43, "Niall Duffy" <niallduffy1988@gmail.com> wrote:

Hi Ger,

Following review from DIT it was recommended that I include some feedback on the evaluation and conclusions drawn from my recent work. I would be very appreciative if you could review below and let me know your thoughts. I have also attached a couple of screen shots of the application. Just an overall opinion of the work, any feedback, what impact you think it could potentially have and any other thoughts or feelings about it that you might have.

Thanks a million.

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Niall Duffy

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